

EUROPEAN ASSESSMENT DOCUMENT

EAD 080002-00-0102

April 2016

**Non-reinforcing hexagonal geogrid for
the stabilization of unbound granular
layers by way of interlock with the
aggregate**

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This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

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1 SCOPE OF THE EAD

1.1 Description of the construction product

The geogrid is an array of multiple hexagons comprising equilateral triangular apertures. These apertures are defined by a structure of monolithic, multi-directional tensile elements of defined orientation, size and shape as indicated in Figure 1.

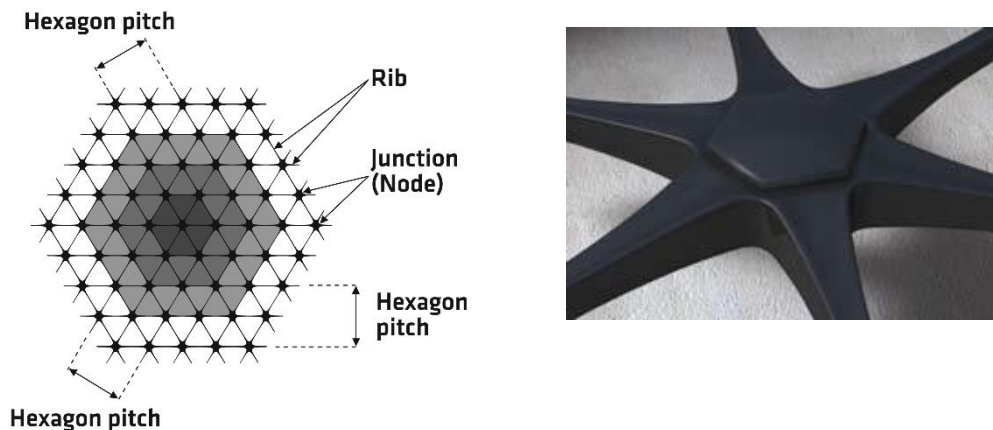


Figure 1 Schematic of geogrid and illustration of integral node

The hexagonal geogrid (see 1.3.1) is manufactured from an extruded homo- or copolymer polypropylene sheet, which is then punched and oriented in three equilateral directions so that the resulting ribs of the triangular apertures have a high degree of molecular orientation which continues through the mass of integral node.

The geogrid can also be supplied bonded with an additional geosynthetic, CE marked, to form a laminated geocomposite.

The product is not covered by a harmonised European Standard (hEN).

Furthermore the intended use “stabilization” is not covered by the Mandates M/107 and M/386 for geotextiles.

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer’s instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer’s stipulations having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA.

1.2 Information on the intended use(s) of the construction product

1.2.1 Intended use(s)

The intended use of the geogrid is to stabilise unbound granular layers in order to minimize deformations during trafficking, to improve the load bearing capacity and to increase the design life of the unbound granular layer in or under trafficked areas, taking into account prevailing national regulations on design methodologies.

Depending on individual circumstances all of the above benefits may not be realised simultaneously. The size and shape of the triangular apertures are dependent on the conditions of use to allow interlocking with unbound aggregate.

The combination of the geogrid and the aggregate creates a mechanically stabilised composite layer with significantly improved properties and performance capabilities in response to dynamic and static loading compared with the aggregate layers alone. See Figure 2.

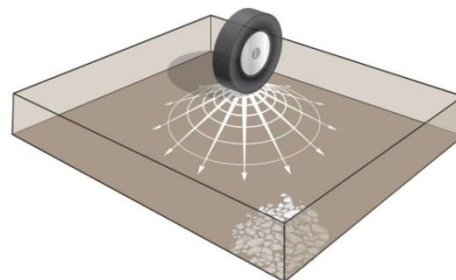


Figure 2: Radial distribution of the traffic load through a granular layer

For some conditions of use the geogrid can be combined with an additional geosynthetic to form a geocomposite which can provide additional or enhanced intended uses. These additional or enhanced intended uses will primarily be filtration or separation, or a combination of the two.

NOTE:

The function of stabilisation is provided by the interlock of the aggregate with the geogrid and subsequent confinement of the particles and addresses the horizontal movement of the granular particles and inhibits the accumulation of strain. An additional effect of stabilisation and the aggregate confinement is the increase in modulus of the granular layer and its associated enhanced resilience, trafficking performance and load bearing capacity.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the geogrid for the intended use of 25 – 50 –or 100 years when installed in the works, provided that the geogrid is subject to appropriate installation and use. These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works¹.

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

¹ The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

1.3 Specific terms used in this EAD (if necessary in addition to the definitions in CPR, Art 2)

1.3.1 Geogrid

In addition to the definition in clause 2.2.1.2.1 of EN ISO 10318-1 the geogrid is an array of multiple hexagons comprised of equilateral triangular apertures.

1.3.2 Geocomposite

In addition with clause 2.2.1.4 of EN ISO 10318-1 the geocomposite is the geogrid combined with a geosynthetic

1.3.3 Geosynthetic

In accordance with clause 2.2.1 of EN ISO 10318-1

1.3.4 Junction (or node)

A junction or node in the context of this product is the interconnection of 6 ribs. See Figure 1

1.3.5 Junction efficiency

Junction efficiency indicates the ability of the geogrid to transfer loads from one rib to other ribs in different directions.

1.3.6 Rib

A rib in the context of this product is the tensile element that connects two nodes. See Figure 1

1.3.7 Mid-rib direction

The mid-rib direction is defined as the direction of the bisector between two adjacent ribs. See Figure 3.

1.3.8 Hexagon pitch

The hexagon pitch is defined as the distance measured between two parallel ribs on the hexagon formed by two opposing triangular apertures.

1.3.9 Radial stiffness

Radial stiffness is the quotient of strength divided by strain, measured at low strain values in a defined radial direction.

1.3.10 Mean Radial Stiffness

The arithmetic mean of the radial stiffness values measured in all the specified directions

1.3.11 Radial Secant Stiffness Ratio

The radial secant stiffness ratio at 0.5% or 2% strain for a sample shall be calculated as the quotient of the minimum and maximum stiffness's at 0.5% or 2% strain measured in the specified test direction.

1.3.12 Isotropic

The term isotropic indicates a high degree of uniformity for defined physical properties of the geogrid in defined radial directions.

1.3.13 Interlock

Interlock is defined as the mechanism by which the geogrid and the aggregate interact under applied load. (During the placement and compaction of a granular layer over a geogrid, the aggregate particles partially penetrate into the apertures and abut against the ribs of the geogrid.)

1.3.14 Confinement

Confinement is defined as the effect of the mechanism of Interlock by which the structure of the geogrid restrains the aggregate particles

1.3.15 Stabilisation

Stabilisation is defined as the beneficial consequence on the serviceability of an unbound granular layer via the inhibition of the movement of the particles of that layer under applied load.

1.3.16 Separation

In accordance with clause 2.1.5 of EN ISO 10318-1.

1.3.17 Filtration

In accordance with clause 2.1.2 of EN ISO 10318-1.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 shows how the performance of the geogrid is assessed in relation to the essential characteristics.

Table 1 Essential characteristics of the geogrid or geocomposite and methods and criteria for assessing the performance of the geogrid or geocomposite in relation to those essential characteristics

No	Essential characteristic <i>(where relevant with footnote*)</i>	Method of verification and assessment	Expression of product performance <i>(value, class, criterion, etc.)</i>
Basic Works Requirement 1: Mechanical resistance and stability			
1	Radial Secant Stiffness at 0,5% and 2,0 strain in rib and mid rib directions	2.2.1	Level
2	Radial Secant Stiffness Ratio	2.2.2	Level
3	Junction Efficiency	2.2.3	Level
4	Hexagon pitch	2.2.7	Level

No	Essential characteristic (where relevant with footnote*)	Method of verification and assessment	Expression of product performance (value, class, criterion, etc.)
Durability aspects relating to the performance of the construction product			
5	Resistance to Weathering	2.2.4	Level
6	Resistance to Oxidation	2.2.5	Level
7	Resistance to acid and alkali liquids	2.2.6	Level

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the geogrid or geocomposite

2.2.1 Radial Secant Stiffness at 0,5% or 2,0 % strain of the Geogrid

The Radial Secant Stiffness at 0,5% or 2,0 % strain in the rib and mid-rib directions (see Figure 3) of the geogrid shall be determined in accordance with the procedure detailed in EOTA TR041 clause B.1. The average Radial Secant Stiffness at 0,5% or 2,0 % strain in the rib and mid-rib directions of the geogrid is to be stated in the ETA in kN/m.

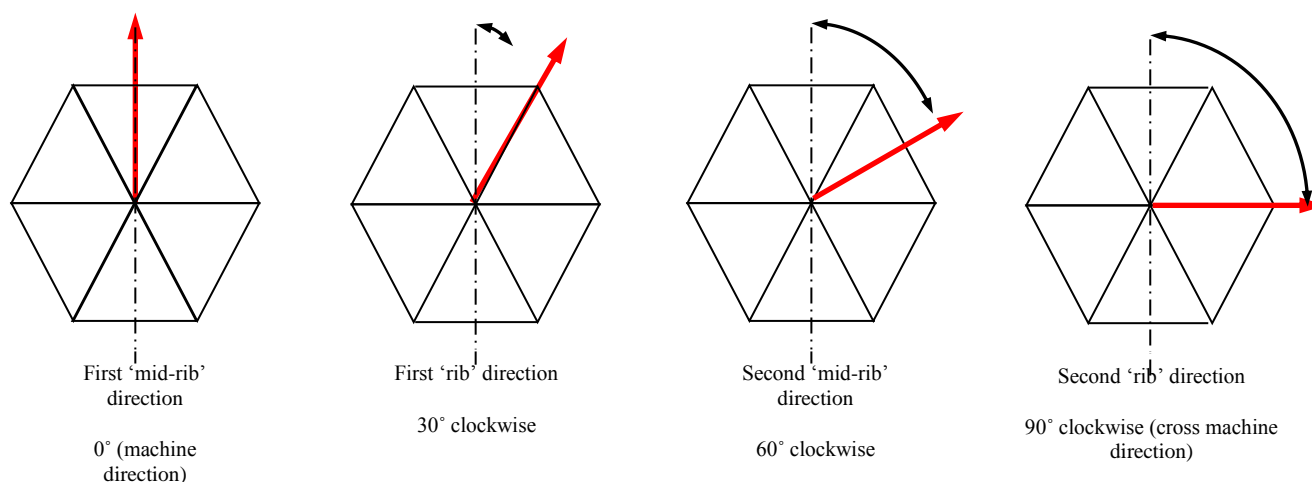


Figure 3 – Four directions of test (2x 'mid-rib' and 2x 'rib' directions)

2.2.2 Radial Secant Stiffness Ratio

The radial secant stiffness ratio of the geogrid shall be determined in accordance with the procedure detailed in EOTA TR041.

The radial secant stiffness ratio is to be stated in the ETA clause B.1.

2.2.3 Junction efficiency

The junction strength efficiency of the geogrid shall be determined in accordance with the procedure detailed in EOTA TR041 clause B.2.

The junction strength efficiency of the geogrid is to be stated in the ETA in %.

2.2.4 Resistance to weathering

The resistance to weathering shall be determined for the geogrid or geocomposite in accordance with EN 12224

The resistance to weathering of the geogrid or geocomposite is to be stated in the ETA as retained strength.

2.2.5 Resistance to oxidation

The resistance to oxidation shall be determined for the geogrid or geocomposite in accordance with EN ISO 13438:2004. The assumed working life assessment is normally based on the maximum soil temperature of 25 °C at a depth of 0,5 m in Europe. Lower soil temperatures have a life prolonging effect on polymers.

For an assumed working life of 25 years, the principle of Method A2 shall be followed (110°C for a period of 28 days).

For an assumed working life of 50 years, the principle of Method A2 shall be followed, with the single deviation that the sample shall be exposed at a temperature of 120°C for a period of 28 days.

For an assumed working life of 100 years is extrapolated based on the methodology as outlined in the working life of 50 years.

The resistance to oxidation of the geogrid or geocomposite is to be stated as a minimum assumed working life in the ETA in years. The performance of all individual components of the product shall be quoted in accordance with Table 3 below.

Note: The justification for the increase in temperature from 110°C to 120°C to provide a type test for an assumed working life of 50 years is the well-known heuristic rule, first attributed to Jacobus Henricus van't Hoff^{2,3}, whereby reaction rates approximately double for each 10°C rise in temperature

Table 3 Resistance to oxidation: soil temperature and assumed working life

Oxidation Test Conditions / Result	Soil Temperature	Assumed Working Life
110°C for 28 days, >50% retained strength	25°C	25 years
	15°C	50 years
120°C for 28 days, >50% retained strength	25°C	50 years
	15°C	100 years

2.2.6 Resistance to acid and alkali liquids

The resistance to acid and alkali liquids shall be determined for each individual component in accordance with EN 14030.

The resistance to acid and alkali liquids of the geogrid is to be stated for each individual component in the ETA.

² S.P. Carfagno and R.J. Gibson, EPRI NP-1558 (1980)

³ R.P. Brown and J.H. Greenwood, Practical Guide to the Assessment of the Useful Life of Plastics, Rapra Technology Limited (2002)

2.2.7 Hexagon pitch

The hexagon pitch of the geogrid shall be measured in accordance with the procedure detailed in EOTA TR041.

The hexagon pitch dimensions of the geogrid is to be stated in the ETA in mm.

3 Assessment and verification of constancy of performance

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act has been specified in the communication of the European Commission⁴ system(s) of assessment and verification of constancy of performance 2+ laid down in the Decision 1996/581/EC of the European Commission⁵ for "Geotextiles" shall also be applied to "Non-reinforcing hexagonal geogrid for the stabilization of unbound granular layers by way of interlock with the aggregate".

The systems are: 2+

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 4.

⁴ Letter of the European Commission of 11 July 2012, marked ENTR/G5/MB/jl ARES (2012) 996274

⁵ Official Journal of the European Communities/Union L 254 of 8.10.1996, p 59-61

Table 4 Control plan for the manufacturer; cornerstones

No	Subject/type of control (product, raw/constituent material, component - indicating characteristic concerned)	Test or control method (refer to 2.2 or 3.4)	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) including testing of samples taken at the factory in accordance with a prescribed test plan					
1. Testing of the non-reinforcing hexagonal geogrid					
1	Radial Secant stiffness at 0,5% strain	2.2.1	Level	2.2.1	1 test specimen per production batch
2	Radial Secant stiffness Ratio	2.2.2	Level	2.2.2	1 test specimen per production batch
3	Junction (node) efficiency	2.2.3	Level	2.2.3	1 test specimen every 3 months
4	Hexagon Pitch	2.2.8	Level	2.2.8	1 test specimen every 3 months
Initial type-testing non-reinforcing hexagonal geogrid and geocomposite					
1. Product testing of the non-reinforcing hexagonal geogrid and declared by the manufacturer					
5	Resistance to weathering	2.2.5	Level	2.2.7	
6	Resistance to oxidation	2.2.6	Level	2.2.8	
7	Resistance to acid and alkali liquids	2.2.7	Level	2.2.9	

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the process of assessment and verification of constancy of performance for the geogrid are laid down in Table 5.

Table 5 Control plan for the notified body; cornerstones

No	Subject/type of control <i>(product, raw/constituent material, component - indicating characteristic concerned)</i>	Test or control method <i>(refer to 2.2 or 3.4)</i>	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control					
1	Inspection of the factory and the factory production control (FPC) as laid down in the control plan	Control of devices, equipment and the documentation of the FPC.			Audit of the production process
Continuous surveillance, assessment and evaluation of factory production control					
2	Surveillance, assessment and judgment of the factory production control (FPC) as laid down in the control plan	Control of the documentation of the FPC			Once a year

4 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment, is of relevance.

EOTA TR041	Non-reinforcing hexagonal geogrid for the stabilization of unbound granular layers by way of interlock with the aggregate.
EN 12224:2000	Geotextiles and geotextile related products Determination of the resistance to weathering
EN 14030	Geotextiles and geotextile related products screening test method for determining the resistance to acid and alkali liquids
EN ISO 10318-1	Geotextiles and geotextile related products – Terms and definitions
EN ISO 13438	Geotextiles and geotextile related products screening test method for determining the resistance to oxidation
EPRI NP-1558 (1980)	S.P. Carfagno and R.J. Gibson, A Review of equipment ageing theory and technology, Electric Power Research Institute, Palo Alto, CA, USA
ISBN 1-85957-312-6 (2002)	R.P. Brown and J.H. Greenwood, Practical Guide to the Assessment of the Useful Life of Plastics, Rapra Technology Limited, Shawbury, Shropshire, UK