HAPAS

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HAPAS Certificate
13/H202
Product Sheet 1

TENSAR GEOGRIDS

TENSAR RE AND RE500 GEOGRIDS FOR REINFORCED SOIL EMBANKMENTS

This HAPAS Certificate Product Sheet(1) is issued by the British Board of Agrément (BBA), supported by Highways England (HE) (acting on behalf of the Overseeing Organisations of the Department for Transport; Transport Scotland; the Welsh Government and the Department for Infrastructure, Northern Ireland), the Association of Directors of Environment, Economy, Planning and Transport (ADEPT), the Local Government Technical Advisers Group and industry bodies. HAPAS Certificates are normally each subject to a review every three years.

(1) Hereinafter referred to as 'Certificate'.

This Certificate relates to Tensar(1) RE and RE500 Geogrids for reinforced soil embankments, a range of uniaxial geogrids manufactured from polyethylene sheet for use as reinforcement in embankments with slope angles up to 70°.

CERTIFICATION INCLUDES:

- factors relating to compliance with HAPAS requirements
- factors relating to compliance with Regulations where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

KEY FACTORS ASSESSED

Soil/geogrid interaction — interaction between the soil and geogrids has been considered and coefficients relating to direct sliding and pull-out resistance proposed (see section 6).

Mechanical properties — short- and long-term tensile strength and elongation properties of the geogrids and loss of strength due to installation damage have been assessed and reduction factors established for use in design (see section 7).

Durability — the resistance of the geogrids to the effects of oxidation, chemical and biological degradation, UV light exposure and temperature conditions normally encountered in civil engineering practice have been assessed and reduction factors established for use in design (see sections 8, 9 and 11).

The BBA has awarded this Certificate to the company named above for the products described herein. These products have been assessed by the BBA as being fit for theirntended use provided they are installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

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Originally certificated on 3 July 2013

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Requirements

In the opinion of the BBA, Tensar RE and RE500 Geogrids for reinforced soil embankments, when used in accordance with the provisions of this Certificate will satisfy the requirements of Highways England and local Highway Authorities for the design and construction of reinforced soil embankments with slope angles up to 70°.

Regulations

Construction (Design and Management) Regulations 2015
Construction (Design and Management) Regulations (Northern Ireland) 2016

Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

See section: 1 *Description* (1.2) and the *Installation* part of this Certificate.

Additional Information

CE marking

The Certificate holder has taken the responsibility of CE marking the products in accordance with harmonised European Standard BS EN 13251 : 2016.

Technical Specification

1 Description

1.1 Tensar RE and RE500 Geogrids for reinforced soil embankments are uniaxial geogrids manufactured from sheet polyethylene, punched and stretched under temperature-controlled conditions. The RE500 grades are manufactured to give enhanced long-term tensile strength performance, where this is required (see section 7).

1.2 The range and specification of geogrids covered by this Certificate are shown Figure 1 and Tables 1 to 3. Each grade of geogrid is available in 1.0 or 1.3 m wide rolls and in either 50 or 75 m lengths, as shown in Tables 1 and 2.

Figure 1 Dimensional details of Tensar RE and RE500 Geogrids

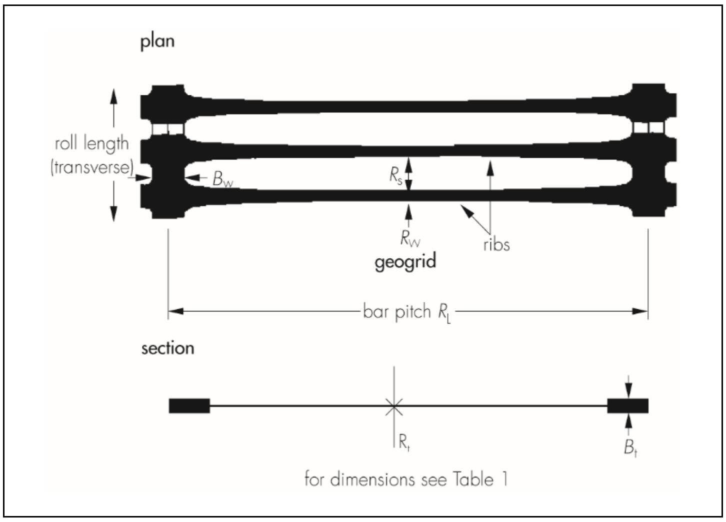


Table 1 Tensar RE Geogrid dimensional data

Dimension[(1)]	Geogrid grade			
	40RE	55RE	80RE	120RE
Bar pitch (R_L)	235	235	235	235
Rib width (R_W)	6.0	6.0	6.0	6.0
Rib thickness (R_t)	0.9	1.1	1.5	2.3
Clear space between ribs (R_S)	16	16	16	16
Bar width (B_W)	16	16	16	16
Bar thickness (B_t)	2.0 to 2.2	2.5 to 2.7	3.6 to 3.9	5.6 to 6.0
Grid mass ($kg{\cdot}m^{-2}$)	0.36	0.45	0.63	0.98
Mean grid size	22 x 235	22 x 235	22 x 235	22 x 235
Mean aperture size	16 x 219	16 x 219	16 x 219	16 x 219
Roll length (m)	50	50	50	50
Roll width (m)	1.0 or 1.3	1.0 or 1.3	1.0 or 1.3	1.0 or 1.3
Weight of roll (kg)[(2)]	19.0 or 25.0	24.0 or 31.0	34.0 or 45.0	51.0 or 67.0
Colour coding[(3)]	Blue	Yellow	Orange	Dark Green

(1) Dimensions in mm unless shown otherwise.
(2) Nominal roll weight dependent on roll width selected.
(3) Colour coding applied to label and roll end (see section 3).

Table 2 Tensar RE500 Geogrid dimensional data

Dimension[(1)]	Geogrid grade					
	RE510	RE520	RE540	RE560	RE570	RE580
Bar pitch (R_L)	235	235	235	235	235	235
Rib width (R_W)	6.0	6.0	6.0	6.0	6.0	6.0
Rib thickness (R_t)	0.8	0.9	1.1	1.5	2.0	2.3
Clear space between ribs (R_S)	16	16	16	16	16	16
Bar width (B_W)	16	16	16	16	16	16
Bar thickness (B_t)	1.8 to 2.0	2.0 to 2.2	2.5 to 2.7	3.6 to 3.9	4.8 to 5.2	5.6 to 6.0
Grid mass ($kg{\cdot}m^{-2}$)	0.29	0.36	0.45	0.63	0.87	0.98
Mean grid size	22 x 235	22 x 235	22 x 235	22 x 235	22 x 235	22 x 235
Mean aperture size	16 x 219	16 x 219	16 x 219	16 x 219	16 x 219	16 x 219
Roll length (m)	75	75	50	50	50	50
Roll width (m)	1.0 or 1.3	1.0 or 1.3	1.0 or 1.3	1.0 or 1.3	1.0 or 1.3	1.0 or 1.3
Weight of roll (kg)[(2)]	23.0 or 30.0	28.0 or 37.0	24.0 or 31.0	34.0 or 45.0	45.0 or 59.0	51.0 or 67.0
Colour coding[(3)]	Brown	Blue	Yellow	Orange	White	Green

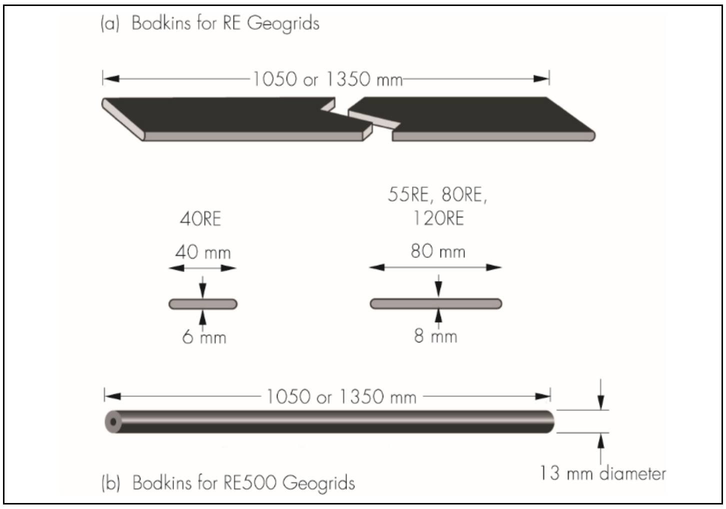
(1) Dimensions in mm unless shown otherwise.
(2) Nominal roll weight dependent on roll width selected.
(3) Colour coding applied to label and roll end (see section 3).

Table 3 Performance characteristics

Product grade	Short term tensile strength (kN per m width)			Strain at maximum tensile strength (%)
	Mean value	Tolerance	T_{char}	
40RE	57.0	--4.2	52.8	11.0 ± 3.0
55RE	68.0	--3.5	64.5	11.0 ± 3.0
80RE	93.0	--4.3	88.7	11.0 ± 3.0
120RE	142.0	--4.7	137.3	11.0 ± 3.0
RE510	46.2	--4.0	42.2	11.0 ± 3.0
RE520	57.0	--4.2	52.8	11.0 ± 3.0
RE540	68.0	--3.5	64.5	11.0 ± 3.0
RE560	93.0	--4.3	88.7	11.0 ± 3.0
RE570	123.0	--4.6	118.4	11.0 ± 3.0
RE580	142.0	--4.7	137.3	11.0 ± 3.0

1.3 Tensar bodkins manufactured from high-density polyethylene (HDPE) bars (see Figure 2) are supplied by the Certificate holder and can be used to join lengths of Tensar RE and RE500 Geogrids when a full strength connection is necessary.

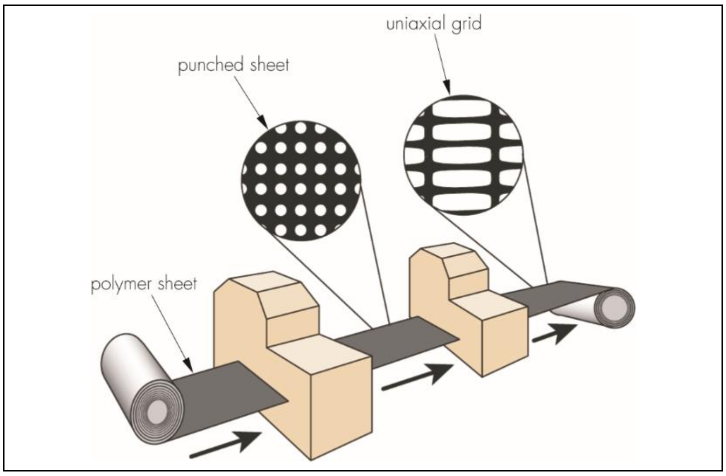
Figure 2 Tensar bodkins



2 Manufacture

2.1 The products are manufactured from an approved list of polyethylene sheet polymers, which are punched and stretched under temperature-controlled conditions to give the required dimensions and short- and long-term tensile strength (see Figure 3).

Figure 3 Manufacturing process



2.2 Tensar bodkins are bought-in to one agreed specification.

2.3 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control being operated by the manufacturer are being maintained.

2.4 The management systems of Tensar International Limited have been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2015 and BS EN ISO 14001 : 2015 by the British Standards Institute Quality Assurance (Certificates Q05288 and EMS86463 respectively).

3 Delivery and site handling

3.1 The geogrids are delivered to site in rolls, bound with self-adhesive tape, bearing the product grade and batch identification references (see Figure 4). In accordance with the recommendations of BS EN ISO 10320 : 1999, the self-adhesive tape is colour coded as identified in Tables 1 and 2. The ends of the rolls are also spray painted to the same colour-coding scheme, to ease identification of the geogrid grade on site.

3.2 In accordance with harmonised European Standard BS EN 13251 : 2016, CE marking is incorporated into the product label.

Figure 4 Label

3.3 The geogrids and bodkins should be stored under cover in clean, dry conditions, protected from mechanical or chemical damage, exposure to direct sunlight and extreme temperatures.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Tensar RE and RE500 Geogrids for reinforced soil embankments.

Design Considerations

4 Use

4.1 When designed and installed in accordance with this Certificate, Tensar RE and RE500 Geogrids for reinforced soil embankments are satisfactory for the reinforcement of embankments with maximum slope angles of 70°.

4.2 Structural stability is achieved through the frictional interaction of soil particles and the geogrids, and the tensile strength of the geogrids.

4.3 The fill specification and method of placement and compaction, the design strength of the reinforcement and the length of embedment of the reinforcement within the compacted fill are the key design factors.

4.4 Prior to the commencement of work, the designer must satisfy the design approval and certification procedures of the relevant Highway Authority.

4.5 In addition to those issues covered in section 6, attention should be paid in design to the following:

- site preparation and embankment construction
- fill material properties
- drainage
- protection of the products against damage from site traffic and installation equipment
- the stability of existing structures in close proximity
- design of the embankment facing.

4.6 The working drawings should show the correct orientation of the geogrids.

5 Practicability of installation

The products are designed to be installed by trained contractors in accordance with the specifications and construction drawings (see the *Installation* part of this Certificate).

6 Design

Design methodology

6.1 Reinforced soil embankments constructed using the geogrids must be designed in accordance with BS 8006-1 : 2010 and the *Manual of Contract Documents for Highway Works* (MCHW), Volume 1 *Specification for Highway Works* (SHW).

6.2 The typical service life given in Table 7 of BS 8006-1 : 2010 for reinforced soil embankments is 60 years.

Geogrid reinforcement

6.3 In accordance with the methodology set out in BS 8006-1 : 2010, Annex 3, the design strength of the reinforcement (T_D) is calculated as:

$T_D = T_{CR}/f_m$

where:

T_{CR} is the long-term tensile creep rupture strength of the reinforcement at the specified design life and design temperature (see section 7)

f_m is the material safety factor to allow for the strength reducing effects of installation damage, weathering (including exposure to sunlight), chemical and other environmental effects and to allow for the extrapolation of data required to establish the above reduction factors.

6.4 The long-term tensile creep rupture strength (T_{CR}) for each grade of geogrid is calculated using the formula:

$T_{CR} = T_{char}/RF_{CR}$

where:

T_{char} is the characteristic short-term strength of the geogrid taken from Table 3

RF_{CR} is the reduction factor for creep (see section 7).

6.5 The material safety factor (f_m) is calculated as:

$f_m = RF_{ID} \times RF_W \times RF_{CH} \times f_S$

where:

RF_{ID} is the reduction factor for installation damage

RF_W is the reduction factor for weathering, including exposure to ultraviolet (UV) light

RF_{CH} is the reduction factor for chemical/environmental effects

f_S is the factor of safety for the extrapolation of data.

6.6 Recommended values for RF_{CR}, RF_{ID}, RF_W, RF_{CH} and f_S, are given in sections 7, 8 and 9. Conditions of use outside the scope for which the reduction factors are defined are not covered by this Certificate and advice should be sought from the Certificate holder.

Soil/geogrid interaction

6.7 There are two limiting modes of interaction between the soil and the reinforcement that need to be considered and for which the length of reinforcement necessary to maintain equilibrium needs to be determined:

- direct sliding — where the soil slides over the layer of reinforcement
- pull-out — where the layer of reinforcement pulls out of the soil after it has mobilised the maximum available bond stress.

6.8 CIRIA SP123 : 1996, sections 4.5 and 4.6 describes the following methods for determining resistance to direct sliding and maximum available bond.

The theoretical expression for resistance to direct sliding is:

$f_{ds} \times \tan \phi'$

where:

f_{ds} is the direct sliding coefficient
ϕ' is the effective angle of friction of soil.

6.9 The direct sliding coefficient (f_{ds}) is calculated as:

$f_{ds} = \alpha_s \times (\tan \delta / \tan \phi') + (1 - \alpha_s)$

where:

α_s is the proportion of plane sliding area that is solid
$\tan \delta / \tan \phi'$ is the coefficient of skin friction between the soil and geogrid material.

6.10 For initial design purposes, the coefficient of skin friction ($\tan \delta / \tan \phi'$) for determining the resistance to direct sliding for the geogrid when buried in compacted frictional fill may be conservatively assumed to be 0.6. Values for the proportion of plane sliding area that is solid (α_s) are given in Table 4. Soil specific testing has shown that values approaching 1.0 can be achieved.

Table 4 Soil geogrid interaction parameters for Tensar RE and RE500 Geogrids

Grade	α_s(1)	Ratio of bearing(2) surface to plan area $\alpha_b \times B/2S$
40RE	0.41	0.003
55RE	0.41	0.004
80RE	0.41	0.005
120RE	0.41	0.008
RE510	0.41	0.003
RE520	0.41	0.003
RE540	0.41	0.004
RE560	0.41	0.005
RE570	0.41	0.007
RE580	0.41	0.008

(1) a_s is the proportion of the plane sliding area that is solid and is required for the calculation of the bond coefficient (f_b) and the direct sliding coefficient (f_{ds}) (see sections 6.7 and 6.10).
(2) The ratio is required to calculate the bond coefficient in accordance with CIRIA SP123 : 1996 (see section 6.10):
- α_b is the proportion of the grid width available for bearing
- *B* is the thickness of a transverse member of a grid taking bearing
- *S* is the spacing between transverse members taking bearing.

6.11 For detailed design, the resistance to direct sliding should be determined from soil and geogrid specific shear box testing.

6.12 The theoretical expression for maximum available bond stress is:

$f_b \times \tan \phi'$

where:

f_b	is the bond coefficient
ϕ'	is the effective angle of friction of soil.

6.13 The bond coefficient may be calculated as:

$f_b = \alpha_s \times (\tan \delta / \tan \phi') + (\sigma'_b/\sigma'_n) \times (\alpha_b \times B/2S) \times (1/\tan \phi')$

where:

α_s	is the proportion of plane sliding area that is solid
ϕ'	is the effective angle of friction of soil
$\tan \delta / \tan \phi'$	is the coefficient of skin friction between the soil and geogrid material
σ'_b/σ'_n	is the bearing stress ratio
$\alpha_b \times B/2S$	is the ratio of bearing surface to plan area.

6.14 For initial design purposes the coefficient of skin friction ($\tan \delta/\tan \phi'$) for determining the bond coefficient for the geogrid when buried in frictional fill may be conservatively assumed to be 0.6. Values for the ratio of bearing surface to plan area ($\alpha_b \times B/2S$) are given in Table 4. Typical values for the bearing stress ratio (σ'_b/σ'_n) are given in CIRIA SP123 : 1996, Table 4.1.

6.15 The BBA recommends that site-specific pull-out tests are carried out to confirm the value of bond coefficient (f_b) used in the final design.

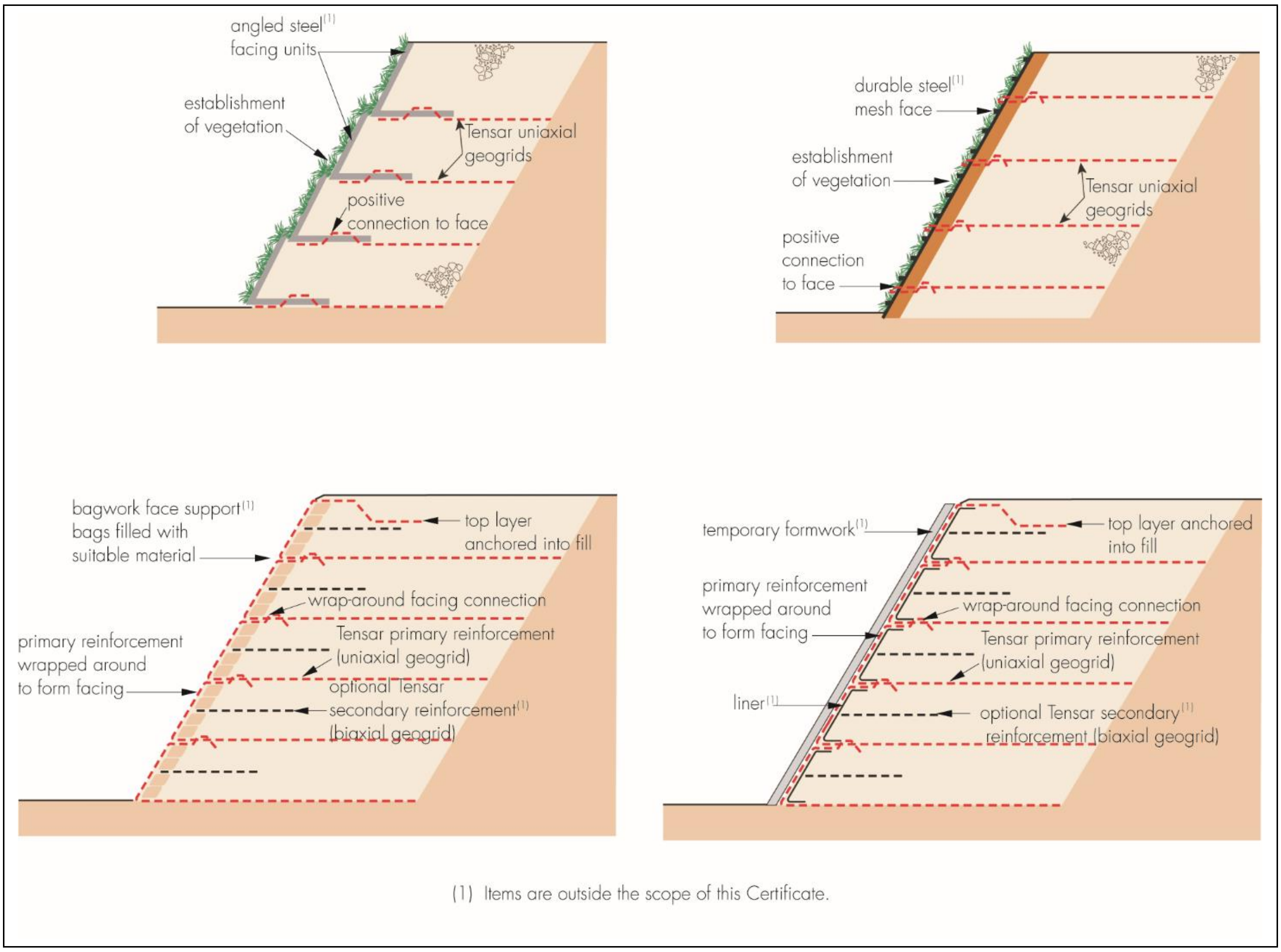
Fill material

6.16 The fill materials must satisfy the requirements of BS 8006-1 : 2010 and the MCHW, Volume 1.

Facings

6.17 Typical facing details are shown in Figure 5.

Figure 5 Facings



6.18 Where the geogrids are used to form the facing, natural or artificial protection must be provided to the grids and fill material to protect the geogrid against damage from UV light, fire and vandalism, and to protect the fill material from erosion.

6.19 Other types of facing including preformed panels, gabions/gabion sacks and other proprietary systems may be used, but are outside the scope of this Certificate. Further guidance is given in BS 8006-1 : 2010.

7 Mechanical properties

Tensile strength – short-term

7.1 Characteristic short-term tensile strength (T_{char}) values and strain values at a maximum load for the product range are given in Table 3.

Tensile strength – long-term

7.2 Long-term tensile strength performance has been established from an extensive programme of creep testing carried out across a range of different test temperatures, including test durations of up to 102,000 hours for the RE Geogrids and up to 100,000 hours for the RE500 Geogrids.

7.3 Using this data and standard time-temperature shift methods (TTS), the Certificate holder has determined the predicted long-term strengths (T_{CR}) given in Table 5 for each grade of RE and RE500 Geogrid, for design lives of 60 and 120 years and for design temperatures of 10°C or 20°C. These values have been independently verified by the BBA using the methodology given in PD ISO/TR 20432 : 2007 and may be used for design.

Table 5 Long-term creep rupture strengths (T_{CR})

Grade	Long-term creep rupture strength (T_{CR}) ($kN \cdot m^{-1}$)			
	60 years		120 years	
	10°C	20°C	10°C	20°C
40RE	24.5	21.8	24.0	21.4
55RE	30.1	26.8	29.5	26.3
80RE	39.9	35.5	39.0	34.8
120RE	64.4	57.4	63.1	56.2
RE510	21.1	19.4	20.7	19.0
RE520	27.8	25.6	27.3	25.1
RE540	34.0	31.2	33.4	30.7
RE560	46.8	42.9	45.9	42.2
RE570	62.4	57.3	61.3	56.3
RE580	72.4	66.5	71.1	65.3

Reduction factor for installation damage *(RF_{ID})*

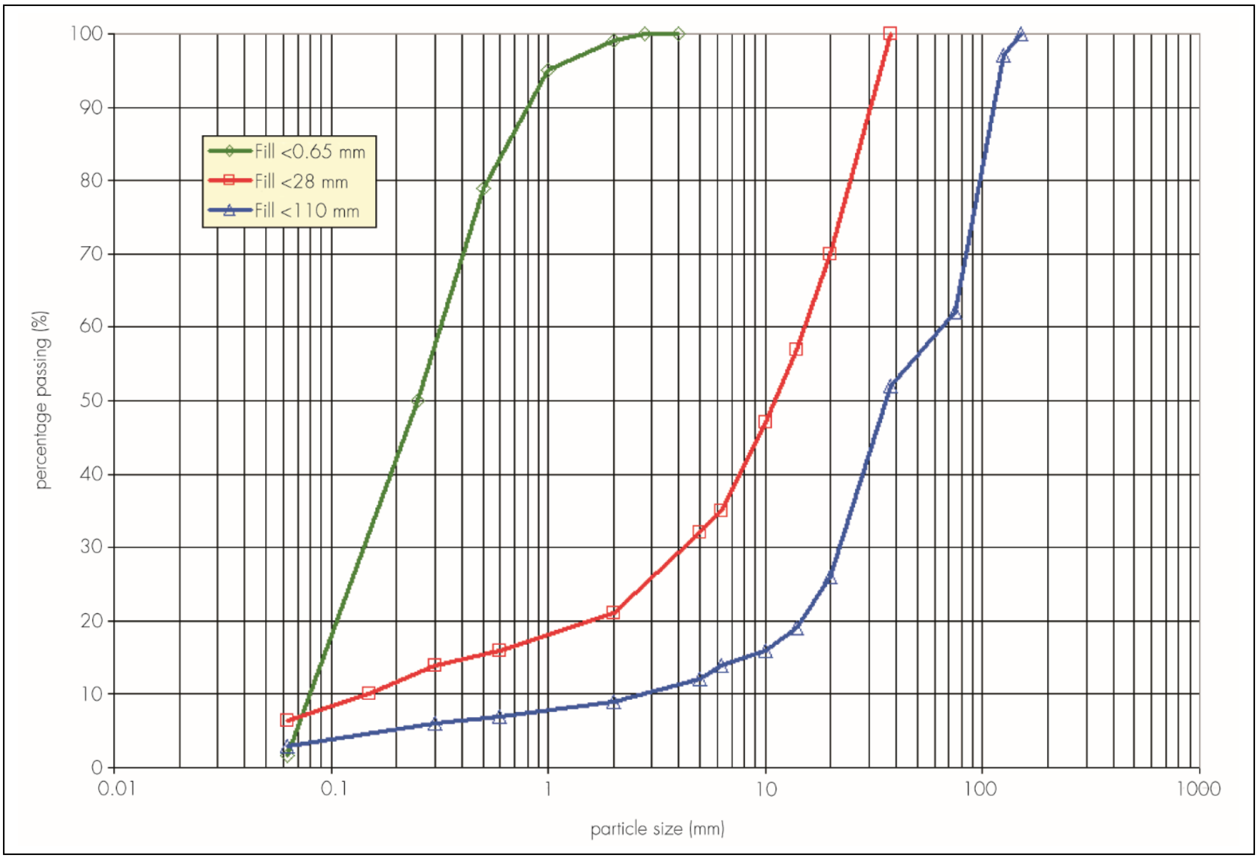
7.4 To allow for loss of strength due to mechanical damage that may be sustained during installation, the appropriate value for RF_{ID} should be selected from Table 6. These reduction factors have been established from full-scale installation damage tests using a range of materials whose gradings can be seen in Figure 6. The reduction factors shown assume a well-graded material (coefficient of uniformity >5) and minimum compacted depth of 150 mm. For fills not covered by Table 4, appropriate values of RF_{ID} may be determined from site-specific trials.

Table 6 Partial safety factor – installation damage (RF_{ID})

Crushed gritstone d_{85} particle size (mm)[1]	Reduction factor for installation damage (RF_{ID})									
	40RE	55RE	80RE	120RE	RE510	RE520	RE540	RE560	RE570	RE580
<0.65	1.00	1.00	1.00	1.00	1.01	1.00	1.00	1.00	1.00	1.00
<28	1.07	1.07	1.07	1.00	1.18	1.07	1.07	1.07	1.07	1.00
<69[2]	1.25	1.20	1.15	1.06	1.30	1.25	1.20	1.15	1.12	1.06
<110	1.48	1.36	1.25	1.12	1.60	1.48	1.36	1.25	1.19	1.12

(1) Determined via full-scale instruction test following the method of Annex D of BS 8006-1 : 1995.
(2) RF_{ID} values interpolated for size 69 mm material.

Figure 6 Particle size distributions of fills used in installation damage testing



8 Effects of environmental conditions

Weathering (including exposure to UV light)

8.1 The geogrids do not show significant reduction in strength after exposure to natural daylight and weathering.

8.2 A reduction factor (RF_W) of 1.00 may be used for design, provided the geogrids are protected from exposure to sunlight in accordance with the recommendations of this Certificate and provided the periods of exposure are limited to a maximum of one month.

Chemical/environmental effects

8.3 The geogrids have good resistance to the effects of chemical and environmental action, including oxidation, resistance to acids and alkaline liquids and microbiological attack. The reduction factors (RF_{CH}) given in Table 7 may be used for design for a design life up to 120 years and a design temperature up to 20°C.

Table 7 Reduction factors

Soil pH value	RF_{CH}
2 to 4	1.05
4 to 12.5	1.00

9 Factor of safety for the extrapolation of data (f_s)

9.1 For the geogrids the factor of safety for the extrapolation of data (f_S) may be taken as 1.00 for a design life of up to 120 years at a design temperature of up to 20°C.

9.2 The above value has been calculated in accordance with PD ISO/TR 20432 : 2007 as specified in BS 8006-1 : 2010, using the R1 and R2 values given in Table 8.

Table 8 R1 and R2 values for determination of f_s

Factor	Taking account of:	Design life (years)	
		60	120
R1	Extrapolation of creep rupture data	1.00	1.00
R2	Extrapolation of chemical data	1.00	1.00

10 Maintenance

As the products are confined within the soil and have suitable durability (see section 11), maintenance is not required.

11 Durability

The geogrids are suitable for use in soil reinforced embankments and will provide a service life of up to 120 years when designed and installed in accordance with this Certificate.

Installation

12 General

12.1 The construction of reinforced soil embankments incorporating the geogrids should be in accordance with the Certificate holder's *Installation instructions*, BS EN 14475 : 2006 and the MCHW, Volume 1.

12.2 Care should be exercised to ensure that the geogrids are laid with the roll length (longitudinal) direction parallel to the direction of principal stress. Design drawings should indicate geogrid orientation (see section 4.6).

13 Procedure

13.1 The geogrid is laid by unrolling it, either manually or mechanically, to the length required and cutting with a suitable device.

13.2 The grids should be laid flat without folds, parallel to each other and with edges in contact to adjacent geogrid. Each reinforcing layer must be continuous in the direction of loading and there should be no overlapping of the grids. Strip misalignment must not exceed 50 mm over a distance of 5 m. Pins or a stretching device may be used to control alignment and also to induce a small pre-stressing load prior to filling.

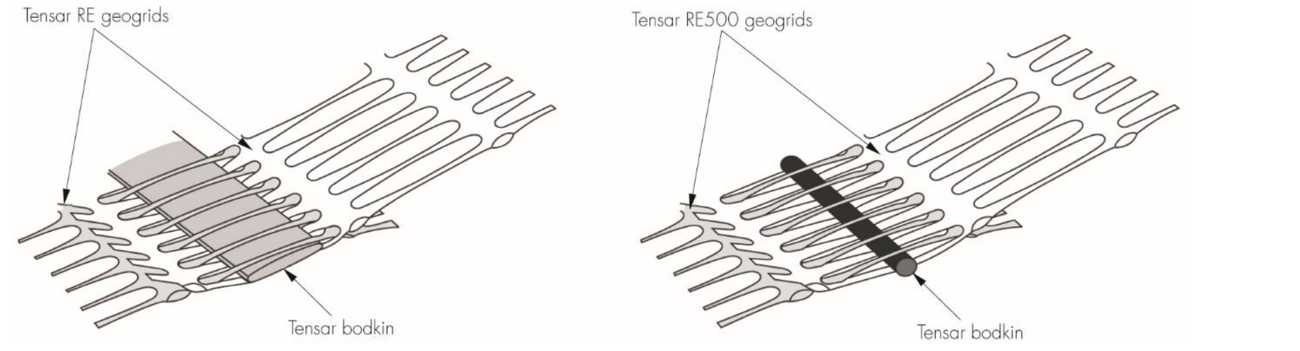
13.3 Fill is placed to a minimum depth of 150 mm, with particular care being taken to ensure that grids are adequately covered before compaction or use by site traffic. Construction plant will damage unprotected geogrids.

13.4 The maximum thickness of compaction layers depends on the design, type of fill and compaction equipment employed, but depths should not exceed 500 mm.

13.5 Facings are positioned as detailed on the engineer's design drawing.

13.6 Tensar bodkins are used to join lengths of geogrid when a full strength connection is necessary (see Figure 7).

Figure 7 Typical bodkin connections



Technical Investigations

14 Investigations

14.1 The manufacturing process of was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

14.2 An examination was made of data relating to:

- short- and long-term tensile properties
- site damage trials and resistance to mechanical damage, assessed according to Annex D of BS 8006-1 : 2010
- resistance to weathering/exposure to sunlight
- resistance to chemical and microbiological attack
- soil/geogrid interaction
- installation procedures and typical details.

14.3 Calculations were made to establish the plane sliding area that is solid and the ratio of bearing surface to plane area.

14.4 The practicability of installation and ease of handling were assessed.

Bibliography

BS 8006-1 : 2010 + A1 : 2016 *Code of practice for strengthened/reinforced soils and other fills*

BS EN 13251 : 2016 *Geotextiles and geotextile-related products — Characteristics required for use in earthworks, foundations and retaining structures*

BS EN 14475 : 2006 *Execution of special geotechnical works — Reinforced fill*

BS EN ISO 9001 : 2015 *Quality Management systems — Requirements*

BS EN ISO 14001 : 2015 *Environmental management systems — Requirements*

BS EN ISO 10320 : 1999 *Geotextiles and geotextile-related products— Identification on site*

CIRIA SP123 : 1996 *Soil Reinforcement with Geotextiles : Jewel R A*,

PD ISO/TR 20432 : 2007 *Guidelines for the determination of the long-term strength of geosynthetics for soil reinforcement*

Manual of Contract Documents for Highway Works, Volume 1 *Specification for Highway Works*

15 Conditions

15.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page – no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document – it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

15.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

15.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

15.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

15.5 In issuing this Certificate the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- actual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to CE marking.

15.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.

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