

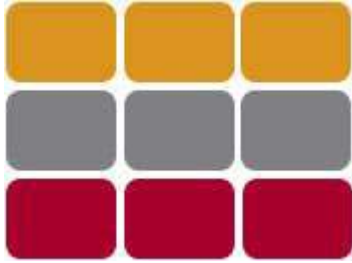


Tensor Products, Systems & Services

Frequently Asked Questions

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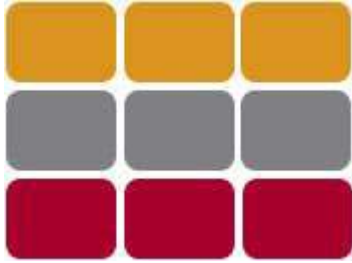


Production, Systems & Services
Frequently Asked
Questions



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Frequently Asked Questions



1. Introduction

The purpose of this document is to provide a list of questions frequently asked by customers and Tensorar's standard responses regarding Tensorar products, systems, services and applications. It is meant for general use by Tensorar personnel, customers and consulting engineers. General answers are provided. Customers should contact Tensorar for more specific information requirements.

2. Products

2.1 Q: How durable are Tensorar geogrids?

A: The durability of any geogrid is dependent on two main factors; the polymer composition and the environment in which it is placed. Tensorar uses high quality virgin polypropylene and HDPE in the manufacture of all geogrids which are recognised as effectively inert to all common in soil degrading mechanisms. Tensorar geogrids are manufactured under a strict Quality Control regime and are required to satisfy the durability requirements in independent approval documentation and audited manufacturing procedures.

Please contact Tensorar for additional information.

2.2 Q: What is the size and weight of a Tensorar roll?

A: Tensorar manufactures a wide range of products which are provided in a range of standard roll sizes. The size and weight of these rolls is governed by the grade and type of material.

Details can be found on the specification sheet or from the Tensorar International website www.tensorarinternational.com

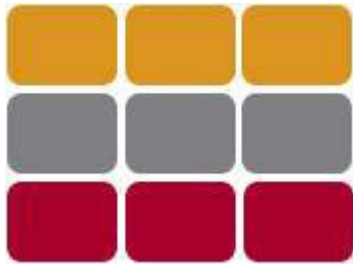
2.3 Q: Can we substitute different types of Tensorar products in a project?

A: The range of Tensorar products have been designed for a variety of applications. We will always specify the most appropriate material for your application, having regard to the most economic and serviceable grid layout. If there are special circumstances, alternative grid layouts using different Tensorar grids may be possible.

Please contact Tensorar for additional information.

2.4 Q: Why should I use Tensorar products when I can find a cheaper alternative?

A: Clearly, not all products are of the same quality. Tensorar produces independently tested, high quality products, with a long track record of proven performance, based upon extensive research and development. Tensorar offers a range of professional services to support the use of our products in your application. Tensorar designs are based solely on Tensorar



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products and the use of alternative products should be accompanied by a design suitable for those products.

Please contact Tensor for additional information.

2.5 Q: Can your new TriAx grids save me more money?

A: The development of TriAx grids has brought benefits of greater savings in aggregate thickness or longer pavement life as compared with the equivalent Tensor biaxial grids. Based on your application, Tensor can evaluate the most cost-effective solution incorporating TriAx and save you money versus traditional construction and Tensor biaxial products.

Please contact Tensor for additional information. or visit the website, www.tensorinternational.com

2.6 Q: Do you offer erosion control products other than Mat200/Mat400?

A: The Tensor Group of companies includes North American Green (NAG), which manufactures rolled erosion control products that are sold via distributors throughout Europe.

For further information please contact NAG www.northamericangreen.com

2.7 Q: What are the benefits of Tensor product?

A: In general Tensor grids are used in many applications to assist the soil in providing safe and cost-effective reinforced and stabilised soil structures. Benefits depend on the application but can include cost saving and extension of pavement life.

Please contact Tensor for additional information or a visit. the website, www.tensorinternational.com

2.8 Q: Where can we find information on Tensor products, systems and services?

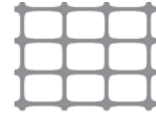
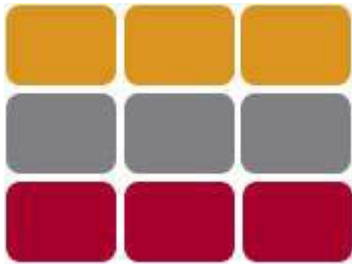
A: Literature is available on the website at www.tensorinternational.com

2.9 Q: Can we save costs and still maintain an attractive appearance for our structure?

A: Yes. There are many different facings available in the Tensartech systems range which provides an attractive finish for Tensor structures. Tensor grid reinforced soil structures usually deliver savings in cost and time over other methods of construction.

Please contact Tensor for additional information. or visit the Tensor website at www.tensorinternational.com

2.10 Q: What are the limits and parameters for Tensor reinforced soil in terms of size, angle and finish?



A: There is a wide scope for Tensorar grid reinforced soil structures. Near vertical single structures over 20m high and much higher stepped structures have been designed and constructed. However specific design limits can only be determined once the actual conditions of the project and requirements for the application are known. It is therefore advisable to contact Tensorar at an early stage to determine whether Tensorar can be used, and if so to develop a concept, design it for construction and incorporate our design in your project.

Examples of completed structures can be found on the Tensorar website at www.tensorarinternational.com Please contact Tensorar for additional information.

2.11

Q: What are your prices?

A: Our prices vary depending on the nature of your project and the Tensorar products and systems to be used.

Please contact Tensorar for additional information.

2.12

Q: Can Tensorar provide budget costs for the construction?

A: Budget costs depend on the nature and type of application required for your project. The purpose of Tensorar's free Applications Suggestion is to provide preliminary confirmation that Tensorar products and systems can be used in your application, and an indication of the quantity of product required. From this budget costs can be estimated. *Please contact Tensorar for additional information.*

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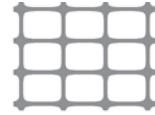
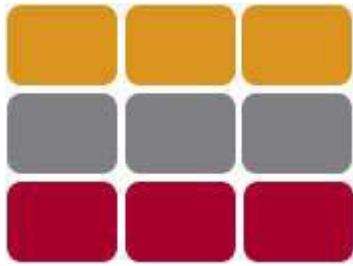
Q: PP and Glass are quite different material, why is Tensorar proposing both?

A: Tensorar proposes a range of products because practical experience demonstrates that, when used in the right environment and installed with quality, each of them performs well.

To start with, stiffness data at low strain levels of grids made of coated glass yarn and grids from stretched PP shows stiffness values in the same range, as demonstrated by independent research at the University of Nottingham.

The tensile properties of coated glass yarn indicates the material will respond very quickly to stress and therefore be particularly suitable to bridge cracks in reflective cracking resistance of thin overlays, while PP features a tolerance to strain and fatigue that makes it well adapted to permanent foundation construction.

Aside from grid material and installation practice, we should keep in mind that the bitumen grade and asphalt formulations form, with the grid a system that contributes as a whole to performance.



2.14 Q: AR1-AR-G: what is the difference?

A: AR-G is really an AR1 grid mounted on a fabric backing. The difference is in the installation method: AR1 needs mechanical anchoring systems while AR-G is glued in a bitumen film intended both to hold the grid during paving, work then as a tack coat and partially a membrane in association with the backing.

2.15 Q: AR1-AR-G: What are the characteristics of a grid suitable for asphalt reinforcement?

A: There are installation, durability and performance considerations to take into account with asphalt reinforcement. Installation is the most important as no one wants things to become more complex than they already are on site. Durability is naturally of importance, both during construction (installation damages) and during the pavement life (de-icing salts, hydrocarbons).

Concerning performance, there is a consensus that grid performance can be described by three parameters;

- Stiffness or modulus. Stiffness at low strain levels is directly related to the ability of the grid to keep asphalt micro-cracks from opening
- Fatigue resistance under repeated loading. Fatigue will be important once the grid starts dissipating cyclic stresses
- Tensile strength is an important input in some reflective cracking models and is typically used for QC purpose. However it is less significant than stiffness.

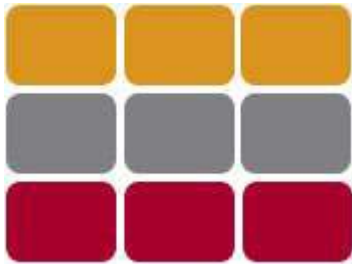
2.16 Q: AR1-AR-G: Is a plastic grid not going to melt during hot asphalt paving?

A: No, these grids can withstand the temperatures typically encountered during installation. The "plastic" used in AR1 and AR-G is a high molecular weight polymer (Polypropylene or PP) that does not have a clear melting point at a specific temperature as found with more typical polymers used in packaging and injection moulded products.

Although the grid would be affected if left for example in an oven at asphalt temperatures for some time, experience shows that the substrate thermal inertia has a strong quenching effect on the asphalt mix leaving insufficient thermal energy to degrade the grid. AR1 has been subjected to a number of investigations in Europe that have well documented the stability of AR1 and AR-G during asphalt construction.

2.17 Q: AR1-AR-G: Is a plastic not too soft to reinforce asphalt?

A: No, the behaviour of these grids is elastic at temperatures and strains typically encountered in pavements. Polymers have been named according to their most apparent property: we call a wax a polymer that melts abruptly into a liquid, rubbers are polymers that have elastomeric properties, plastics are polymers that present a blend of elastic and plastic behaviours. In fact polymers such as the PP grade used in manufacturing AR1 and AR-G present



more elastic than plastic properties at ambient road surface temperatures. During manufacture of these grids, it is actually not until at least 160°C that this polymer presents properties sufficiently plastic for the stretching process, during which the polymer molecules are forced mechanically to align. This manufacturing process allows Tensar grids to develop their high stiffness and an entirely elastic response under traffic loading.

2.18

Q: Glasstex-AR-G: Is a grid/fabric composite product not going to cause de-bonding of the pavement layers?

A: No, when correctly installed this is not a problem. It may seem logical that introducing a grid/fabric composite product might create a shear plane at the interface between layers that would be detrimental to bonding. This is not the case. The AR-G and Glasstex fabrics, once saturated with bitumen, can actually more evenly distribute the stresses during shear testing, thus providing in comparative tests the same or sometime even higher bonding strength than comparative asphalt to asphalt layers.

Experience shows that de-bonding of test cores can however result from one or both of the following installation related factors:

- Insufficient bitumen tack coat where the spray rate or substrate porosity has been underestimated, or the emulsion runs off
- An emulsion has been used and insufficient time has been allowed for curing; the tack coat still contains water at the time of testing.

It is important to realise that test core de-bonding does not mean the project should be condemned. It will just take longer for the emulsion to cure and meanwhile, the grid will prevent slippage from occurring.

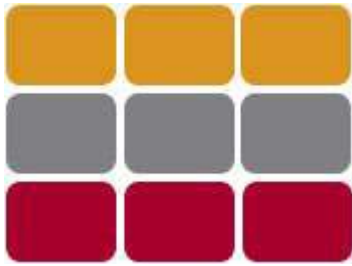
2.19

Q: Can we recycle the materials?

A: This is a multi faceted question that requires several answers:

- If we mean by this question, "can the grid be recovered after time and re-used in asphalt?" The answer is no, it would not be practical.
- If we mean, "can the asphalt be milled off?", the answer is yes, provided the milling depth is clearly above or below the grid location; as it is otherwise possible for the grid to get wrapped in the cutting drum. The grid/fabric will be chopped into small pieces (with occasional larger chunks) that will not interfere with the milling process
- If we mean, "can we recycle the milled asphalt containing chopped grid?" The answer is also yes, particularly if the reclaimed asphalt has been screened to remove any larger pieces of grid/fabric.

It is however not the objective to have to recycle this grid in the future as the material is durable and can exceed 100 years of working life. Such grids should preferably be used to build permanent asphalt foundations at minimum material and construction cost.



2.20

Q: What equipment do I need to place asphalt reinforcement grids?

A: Tensorar usually recommends to use a specialist installer. The essential piece of equipment is a properly calibrated bitumen sprayer (hot, emulsified or even foamed if available).

For small areas the grids can be installed by hand. However for larger areas specialist installers provide purpose built equipment to install the grid.

2.21

Q: How to avoid problems on site?

A: The simplest solution is to use a specialist installer or at least a dedicated team, including the sprayer operator.

If working with a new team, always run a training session and rehearsal before going on site. Make sure all are informed of the process.

At least initially, assign a team of two to follow the grid behaviour during construction and ready to take remedial action should a problem occur.

3. Services

3.1

Q: What is the normal time for receiving Tensorar Application Suggestions or Designs?

A: Tensorar will provide a free Application Suggestion, which is a not for construction application concept, within 7 days of receipt of required information from you. Tender submissions for Design & Supply projects can be provided within 7 – 10 days of receiving required information. Design and drawings for a Design and Supply contract will normally be completed within 2 – 4 weeks of receipt of the order and the required design brief information.

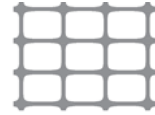
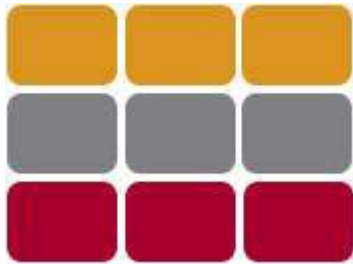
Please contact Tensorar for additional information.

3.2

Q: We received a Tensorar tender design and supply submission some time ago and would like to place an order in the near future. What do I need to do?

A: First of all you need to ensure that there are no changes to the project which might impact our design. We would require current project information in the form of an updated design brief. After reviewing this information we would either confirm that the original design is still applicable or provide a revised design. We will notify you of any cost implications associated with redesign or price increases associated with time lag.

Please contact the local Area Sales Engineer to discuss the project and notify any changes that may have been made to the original design brief.



3.3

Q: Can someone come on site to show us how to install the Tensorar products/structure?

A: Yes. A site visit at the start of construction is offered as part of Tensorar's standard Design & Supply service, but can be extended to other projects in which Tensorar products are used. The purpose of this visit is to describe and demonstrate the techniques required to correctly install Tensorar products in your project. We strongly recommend that all contracting personnel carrying out installation to be present for our construction sequence demonstration.

Please contact Tensorar to arrange a site visit. Construction Sequences for the various Tensorar structures are also available on the website at www.tensorarinternational.com

3.4

Q: Can you provide a certified design?

A: Yes. Tensorar carries out the design of Design and Supply projects on the basis of a Design Brief which defines all the parameters and is agreed between Tensorar and Tensorar's customer. All Consultants carry out their design work under a duty of 'due skill and care' and Tensorar follows that same principle.

Please contact Tensorar for additional information.

3.5

Q: What does "a duty of skill and care" mean?

A: In legal documents 'due skill and care' is the phrase that is normally used to describe the duty that a Design Engineer has in preparing work. A Design Engineer is required to use the level of professional expertise that would normally be expected of an individual with his level of qualification and experience.

Please contact Tensorar for additional information.

3.6

Q: Do you provide any after sales/post contract technical service?

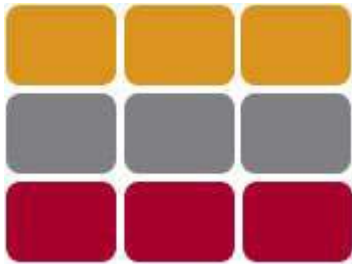
A: Yes. Tensorar provides support for sales of our products and systems. Tensorar representatives can provide information and advice before the start of construction on installation techniques and will be available for consultation regarding practical issues impacting on installation and performance of Tensorar products and systems during construction.

Please contact Tensorar for additional information.

3.7

Q: Can you issue an as built drawing?

A: Tensorar personnel are not present at all stages of construction and are therefore unable to confirm whether the actual construction conforms to the contract drawings. It is appreciated, however, that the contract drawings have been produced by Tensorar and the status of these may be revised on



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written and signed assurance from the contractor that the construction has been carried out accurately and correctly.

Please contact Tensorar for additional information.

3.8 Q: Can you certify that we have built the wall in accordance with your design drawings?

A: No. Tensorar does not offer construction supervision services, is not present during the whole construction process and will normally visit the site infrequently at your request. We are therefore not in a position to say whether or not the construction is in accordance with our design.

Please contact Tensorar for additional information.

3.9 Q: Do you maintain professional indemnity (PI) insurance?

A: Yes. We consider PI insurance to be an important part of our risk management approach and an appropriate financial protection for Tensorar and our customers in the event of an error or omission. PI is purchased annually and responds to claims made during the period of the policy. We are committed to maintaining our PI insurance with reputable international insurers.

Please contact Tensorar for additional information.

3.10 Q: What is the difference between an Application Suggestion and Design?

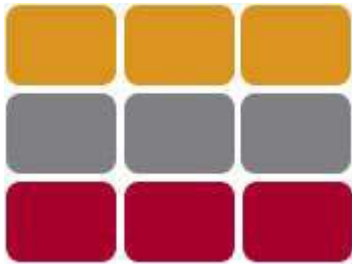
A: An Application Suggestion is a preliminary concept whose purpose is to demonstrate whether and how a Tensorar application could be used to satisfy the project need. It is generally based on incomplete or assumed information and is therefore not intended for construction. Tensorar can take on the role of designer of the reinforced soil structure involving Tensorar products and systems. The design provided by Tensorar is meant for construction and is based upon clearly defined information provided by you or your consulting engineer, which is contained in a design brief.

Please contact Tensorar for additional information.

4. Systems and Applications

4.1 Q: Can Tensorar design a large noise bund?

A: Yes The design of a large reinforced soil noise bund is similar to the design of other reinforced soil structures such as vertical walls and steep



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slopes. In order to carry out a design the geometry of the required structure and the soil properties of the fill and foundation soils will be required.

Please contact Tensor for additional information.

4.2

Q: Can I further optimise the wall design?

A: A wall design from Tensor is based on the agreed information as summarized in the design brief. The design has been developed by the Tensor design team as an efficient and cost effective solution applying design parameters contained in the design brief incorporating Tensor products. Clearly Tensor can not be responsible for any changes to the design outside Tensor's control. *Please contact Tensor for additional information.*

4.3

Q: Can we change the soil parameters?

A: Yes. Tensor is not responsible for establishing soil parameters and relies on information provided by you or your consulting engineer. This information is contained in the design brief which sets out the advice you or your consulting engineer have provided. The design brief forms the basis for Tensor design of a structure incorporating our products and systems. If the soil parameters on which the design is based have changed a new design brief, incorporating these changes, is required and a new Tensor design will be provided to you.

Please contact Tensor for additional information.

4.4

Q: Will the design be further optimised by changing the soil parameters?

A: It may be possible to further optimise the Tensor design by providing improved soil parameters in your brief to our design team. Prior to providing Tensor with changed soil parameters, we strongly recommend that you validate these by testing or review and confirmation from your geotechnical engineer.

Please contact Tensor for additional information.

4.5

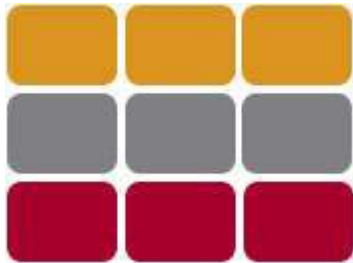
Q: Can Tensor confirm material properties and factors used in design?

A: Tensor has been very active in achieving external approval certification for Tensor geogrids. All Tensor material properties used in design are derived from this documentation and can therefore be confirmed. The values provided depend on the particular application and design method. The fill material properties on which the design is based are given in the Design Brief, which has been agreed, and should be confirmed by the contractor

Please contact Tensor for additional information. or visit the Tensor website: www.tensorinternational.com

4.6

Q: Can Tensor design a traffic barrier?



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A: The traffic barrier is an independent structure which should be designed for independent stability although the influence of the barrier on the reinforced soil structure is taken into account in Tensor's designs. Whilst Tensor is not in a position to design the barrier themselves we can work with an independent engineer on that aspect of the project..

Please contact Tensor for additional information.

4.7 Q: How can we demonstrate the economic benefit of the Tensor application?

A: The economic comparison of Tensor suggestions and designs against other methods of construction depends on many factors and should be carried out on specific proposals to give an accurate picture. We can, however, give some typical examples of cost benefits from case studies.

Please contact Tensor for additional information.

4.8 Q: Can you design a piling mat/sub base?

A: Yes. We can usually design a piling mat/sub base using Tensor products and systems. We require you to provide information for our design brief including the soil parameters and the loading cases from the construction equipment.

Please contact Tensor for additional information.

4.10 Q: Can you design a retaining wall?

A: Yes. Tensor has developed a number of Tensartech systems for reinforced soil walls with different facings.

Please contact Tensor for additional information, or visit the Tensor website at: www.tensorinternational.com

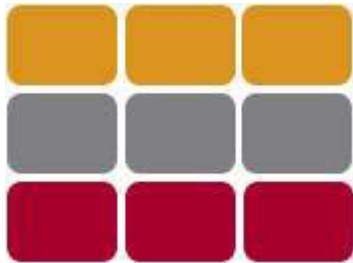
4.9 Q: Can you design a vegetated reinforced soil slope?

A: Yes. Tensor has developed a number of Tensartech systems for reinforced soil steep slopes with different facings including vegetated options.

Please contact Tensor for additional information. or visit the Tensor website at: www.tensorinternational.com

4.10 Q: With low CBR, what solution can Tensor provide?

A: Tensor has worked successfully in the construction of roads over low CBR soils for many years. The inclusion of Tensor stabilisation grids in the granular layers of pavements enables efficient construction in very difficult circumstances.



Please contact Tensor for additional information or, for examples of this application, please visit the Tensor website at www.tensorinternational.com.

4.11

Q: What is the benefit of using Tensor geogrid in road sub base?

A: A number of benefits result from the inclusion of Tensor stabilisation grids in the granular layers of a road construction including, among others, the reduction of the amount of granular material required or the extension of the life of the pavement.

Please contact Tensor for additional information.

4.12

Q: Can you look at my project and let me know if you can propose one of your solutions for use?

A: Yes. Tensor provides an Application Suggestion service which is a preliminary concept whose purpose is to demonstrate whether and how a Tensor application could be used to satisfy the project need. It is generally based on incomplete or assumed information and is therefore not intended for construction but may provide the basis to take the project further towards a more formal proposal.

Please contact Tensor for additional information.

4.13

Q: Can I reduce stone thickness in pavements by use of Tensor geogrids?

A: Yes, generally by between 30 and 40%. The design needs to be based on strength of formation and expected construction traffic, which is based on the area of the pavement.

Please contact Tensor for additional information.

4.14

Q: I have soft ground with a CBR of less than 1%. Can you recommend a suitable product to reinforce a temporary access road for a building development?

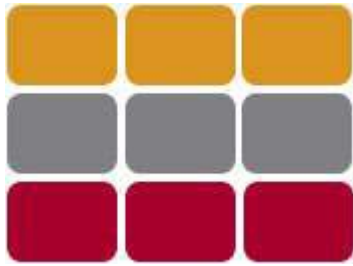
A: The production of a serviceable access road is a combination of both the Tensor stabilisation grid and the aggregate. The thickness of aggregate required is dependent on the amount of traffic the road is required to carry. At CBR values less than 1% the normal recommendation would be Tensor TX170 but the aggregate thickness needs to be calculated in order to provide a serviceable access road

Please contact Tensor for additional information.

4.15

Q: What information do I need to provide you with so that you can help me compare the difference of a Tensartech wall and a reinforced concrete wall?

A: Each project has its own specific requirements. If you can provide basic geometry and soil parameters for your particular situation Tensor can



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provide an Application Suggestion based on that information to enable a preliminary comparison to be made.

Please contact Tensorar for additional information.

4.16

Q: Can I use a geotextile in place of a grid?

A: No, not if the design is based on the use of a grid.

4.17

Q: What information do you require to assist me to reduce the granular layer thickness?

A: Our design team will need to know the footprint of the application, preferably by a drawing, the application construction phase traffic, the ground conditions (type including CBR value or Cu value) and the finished use.

Please contact Tensorar for additional information.

4.18

Q: Can you provide an RE solution compared to this RC wall?

A: Yes. Tensorar can generally submit an alternative Application Suggestion so that a comparison can be made.

Please contact Tensorar for additional information.

5. Construction

5.1

Q: Is this fill OK?

A: The geotechnical properties of the fill material used in reinforced soil structures are critical in the design, can not be verified by visual inspection and would ideally be determined from testing for complete accuracy. The properties of fill products can be highly variable dependent on source. Geotechnical engineers familiar with the fill materials in question and their variability may be able to provide approximate parameters or advice on a suitable testing programme.

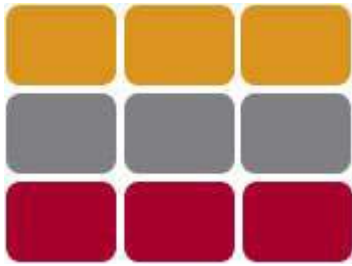
Please contact Tensorar for additional information.

5.2

Q: We are having some problems with the construction. Can somebody come and give us some advice?

A: Yes. A Tensorar representative can visit the site at your request to give information and advice relating to the correct installation of Tensorar product. This does not extend to inspection and certification or to any form of supervision.

Please contact Tensorar for additional information.



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5.3

Q: Do you supervise installation?

A: No. Tensorar does not offer supervision services, and does not have the authority to direct or control the workforce or construction equipment.

5.4

Q: Can I pile behind the face of this retaining structure?

A: This might be possible depending on the proximity of the piles to the wall face. The elimination of a section of grid may require a reassessment of the Tensorar design. If you have engaged Tensorar to carry out design, you should provide all information regarding the proposed piles should to your Tensorar design team.

Please contact Tensorar for additional information.

5.5

Q: We have decided that we want to build the wall 3m higher. Can we just use the same grid layout?

A: No. In all structures the design is specific to the actual dimensions and soil parameters provided and therefore any changes in geometry require a new design assessment.

Please contact Tensorar for additional information.

5.6

Q: Can I leave the geogrid exposed to sunlight or will it degrade due to UV exposure?

A: This depends on the time period involved and the geographical location of the project. In principle the geogrid has UV degradation inhibitors and can typically remain exposed for short periods of time (several weeks) during construction, BUT all polymers degrade in UV and we would need to be clear about the specific circumstances of the project before giving a definitive answer.

Please contact Tensorar for additional information.

5.7

Q: Will you visit site on a regular basis to inspect progress of our works?

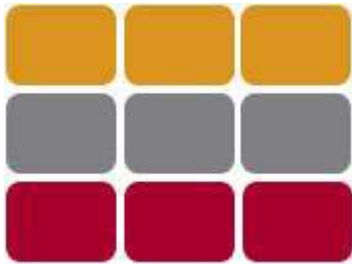
A: No. Tensorar does not offer supervision nor inspection services. A Tensorar representative will provide general information advice on the construction sequence at the start of the work and can visit the site, upon your request, to comment on practical aspects of installing Tensorar during construction.

Please contact Tensorar for additional information.

5.8

Q: Are there any installation guidelines for Tensorar products and systems?

A: Tensorar provides a comprehensive range of practical information and guidance for the safe handling, storage and installation of Tensorar products. These are called construction sequences.



Please contact Tensor for additional information or visit the Tensor website, to download the relevant construction sequence.

5.9

Q: Should the RE grid be pre-tensioned during construction of the wall?

A: Tensor can provide you with a construction sequence to give guidance on Tensor reinforced soil wall construction. There is a requirement to pull the RE reinforcing grid to remove any slackness from the grid and any connections but this is not a formal pre-tension.

Please contact Tensor for additional information or visit the Tensor International website at www.tensorinternational.com to download the information.

5.10

Q: Do you lap the grid?

A: Yes, but only in certain applications. For example, in stabilisation applications the amount of overlap depends on the conditions but is generally between 300mm and 600mm.

6. Maintenance

6.1

Q: If there was a road accident or fire and the face is damaged, is that OK?

A: Normally this causes face damage only and a remediation program may be required to repair the damage. The reinforced soil structure is actually the Tensor grid and the soil with the facing providing erosion protection and an aesthetic finish. There should not be any structural damage from the event as long as the repair is carried out without delay to protect the exposed soil face.

Please contact Tensor for additional information.