T-Value

A new direction for working platforms.

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Introduction

Tensar's new design approach, the T-Value Method, is based on the relationship between bearing capacity and the load transfer efficiency of a granular layer, expressed as a T-value.

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Working Platforms and Piling Mats

Temporary working platforms are important aspect of many construction projects, providing stable and safe working areas. Piling mats are working platforms designed specifically to carry the heavy static and dynamic loads from piling rigs, their support cranes and associated equipment.

Often placed over weaker subgrades, temporary working platforms are typically built using well-graded, compacted granular fill, such as natural gravels and crushed rock, as well as recycled demolition material. Geogrids can be incorporated in the granular material to stabilise it and increase bearing capacity, and platforms are designed to be free-draining, to prevent a build-up of water on the surface.

The Importance of Safety

The UK's Federation of Piling Specialists (FPS), estimates that a third of all dangerous occurrences reported by its members are related to piling mats – a soft spot just 1m^2 can cause a rig to topple, with the potential for devastating consequences. Safety in design, construction and maintenance is obviously of paramount importance.

The FPS recommends that piling mats should be inspected daily to ensure they are in proper working condition. If any excavations, trenches or holes have formed in the surface, they must be properly backfilled to ensure they are as stable as the rest of the mat.

Every site with an operational piling rig has to have a Working Platform Certificate, which confirms the piling mat has been properly designed, and constructed in accordance with the design, and that it will be regularly inspected and maintained. This is signed by the principal contractor and provided to the piling contractor before work starts.

Source: www.heavyliftnews.com/accidents/tragic-crane-accident-vungtau-vietnam

Federation of Piling Specialists FPS
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Designing Temporary Working Platforms and Piling Mats

Temporary working platform design should be carried out by a competent person, and preferably a geotechnical engineer. Design depends on ground conditions and the groundwater regime, and so requires sufficient ground investigation data.

Platform thickness depends on subgrade strength, the platform materials and, of course, the expected construction loads – piling machinery, in particular, is some of the heaviest on site. It is important to have a platform that can provide sufficient bearing capacity for safe working, while being economic and straightforward to construct.

If the platform is being built over particularly loose and weak soils, additional ground treatment may be needed before it is built.

Design, Verification through Testing and Benefits

Design Guidance GO→

Verification of Working Platforms through Plate Load Testing GO→

The Benefits of Stabilising Geogrids in Working Platforms GO→

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Design Guidance

The key document for UK designers is BR470 Working platforms for tracked plant, which includes guidance on the design, construction, operation and maintenance of working platforms. It was written by by the Building Research Establishment under the direction of the FPS.

In 2011, BRE published a supplementary document, Use of structural geosynthetic reinforcement – A BRE review seven years on. This recognises that alternative design methods can be used, including platforms built using granular material mechanically stabilised with geogrid, as long as designs are based on 'credible and representative' research and project case studies.

BR470 Working platforms for tracked plant

Includes guidance on the design, construction, operation and maintenance of working

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Other guidance includes:

Federation of Piling Specialists Guide to Working platforms

View Now GO→

The European Federation of Foundation Contractors and Deep Foundations Institute's

View Now GO→

The Institution of Civil Engineers Temporary Works Forum's Working platforms – Design of granular working platforms for construction plant

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Verification of Working Platforms Through Plate Load Testing

BR470 recommends that the design and construction of working platforms should be carried out using plate load tests. A plate load test involves the increasing loading of a circular steel plate placed on a ground surface and measuring the settlement induced, to determine bearing capacity.

Plate load tests typically use 0.3m or 0.6m diameter plates, with the size of the pressure bulb created (and therefore the depth of ground being tested) being related directly to the size of the plate – typically twice its diameter (so about 0.6m depth for a 0.3m diameter plate).

Plate load tests typically use

0.3m | 0.6m

diameter plates, with the size of the pressure bulb created being related directly to the size of the plate

To learn more about the best approach for plate load testing watch our **Ground Coffee video here...**

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The Benefits of Stabilising Geogrids in Working Platforms

Incorporating stabilising geogrids in the granular material used to form a working platform can improve bearing capacity, while being up to half the thickness of a non-stabilised granular layers.

This is because of the interlocking mechanism and particle confinement that develops between the aggregate and the geogrid. This prevents lateral movement of the granular material, creating a mechanically stabilised layer that increases bearing capacity and controls differential settlement.

Additionally, lower quality and recycled granular fill can be used and together, this can save time and money through reduced excavation and imported materials, as well as reducing the platform's carbon footprint.

To learn more about mechanical interlock watch our **Ground Coffee video here...**

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Design, Verification through Testing and Field Trials

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Tensar's T-Value Design Method

Tensar's T-value design method enables a more accurate assessment of the positive effect of stabilising geogrids on the bearing capacity of a granular working platform.

Applicable to a range of working platform materials, in different ground conditions, the method allows designs with, or without, geogrid to be compared, including for very low subgrade shear strengths. It can also be applied to surface and shallow embedded foundations, with dry or saturated granular layers.

For the first time, the full benefits of stabilising geogrids can be incorporated consistently in designs for working platforms. It delivers verifiable designs that can reduce platform thickness and improve bearing capacity, cutting construction costs by up to 30% and reducing a platform's carbon footprint by up to 40%.

£ Cutting construction costs by up to **30%**

CO_2 Reducing a platform's carbon footprint by up to **40%**

Tensar GROUND Coffee

To learn more about our T-Value design methodology for working platforms, watch our **Ground Coffee video here….**

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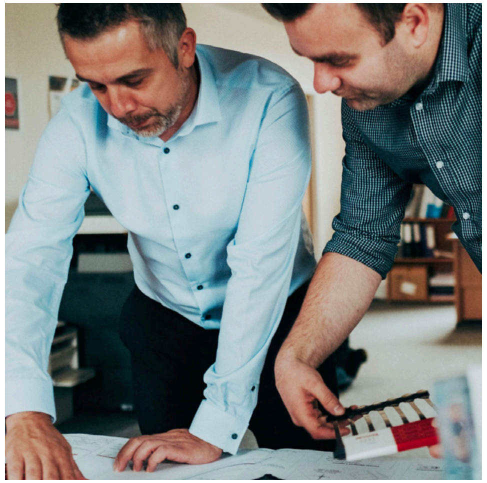
How T-Value Differs from other Design Methods

What makes the T-Value design method different from other methods is that, for the first time, the performance of a composite of granular material and stabilising geogrid can be analysed. This gives a truer prediction of performance and also allows designers to compare this performance with that of non-stabilised materials.

While in theory, the T-Value Method can be applied to other granular materials and geogrids, the relationship between the T-Value and subgrade strength that has been derived is for Tensar geogrids alone. If other aggregates and geogrids are to be used, the relationship must be derived through FEA and laboratory testing and validated using full-scale testing appropriate to the platform or foundation being built.

While BR470 considers geosynthetics, their effects are based upon manufacturers' guidance, which can lead to inconsistency and uncertainty during design checks. Existing methods are either overly-simplified (eg a common load spread angle for all cases) or use obscure, hard-to-understand empirical input parameters.

Furthermore, a granular material's bearing capacity and a geosynthetic's tensile strength are considered separately. This is inappropriate to stabilising geogrids because, as discussed, rather than acting in tension to reinforce granular material, the aggregate and geogrid perform as a composite, due to interlocking and particle confinement in the geogrid's apertures.



Verification of the T-Value Design Method through Laboratory Testing

The T-Value design method was developed using finite element analysis (FEA) of granular layers stabilised with geogrid.

However, FEA models used in geotechnical design characterise geogrid in terms of its in-air tensile stiffness or strength properties, together with the mechanical characteristics of the soil without geogrid, often measured using triaxial tests.

This can lead to significant under-prediction of stabilisation geogrid performance, because this depends critically on the mechanical interlock between the aggregate particles and the geogrid apertures. Triaxial testing of the aggregate and geogrid together overcomes this, as it enables the performance of a composite material to be measured.

500 Large scale triaxial tests carried out

To learn more about triaxial testing, **watch our Ground Coffee video here.**

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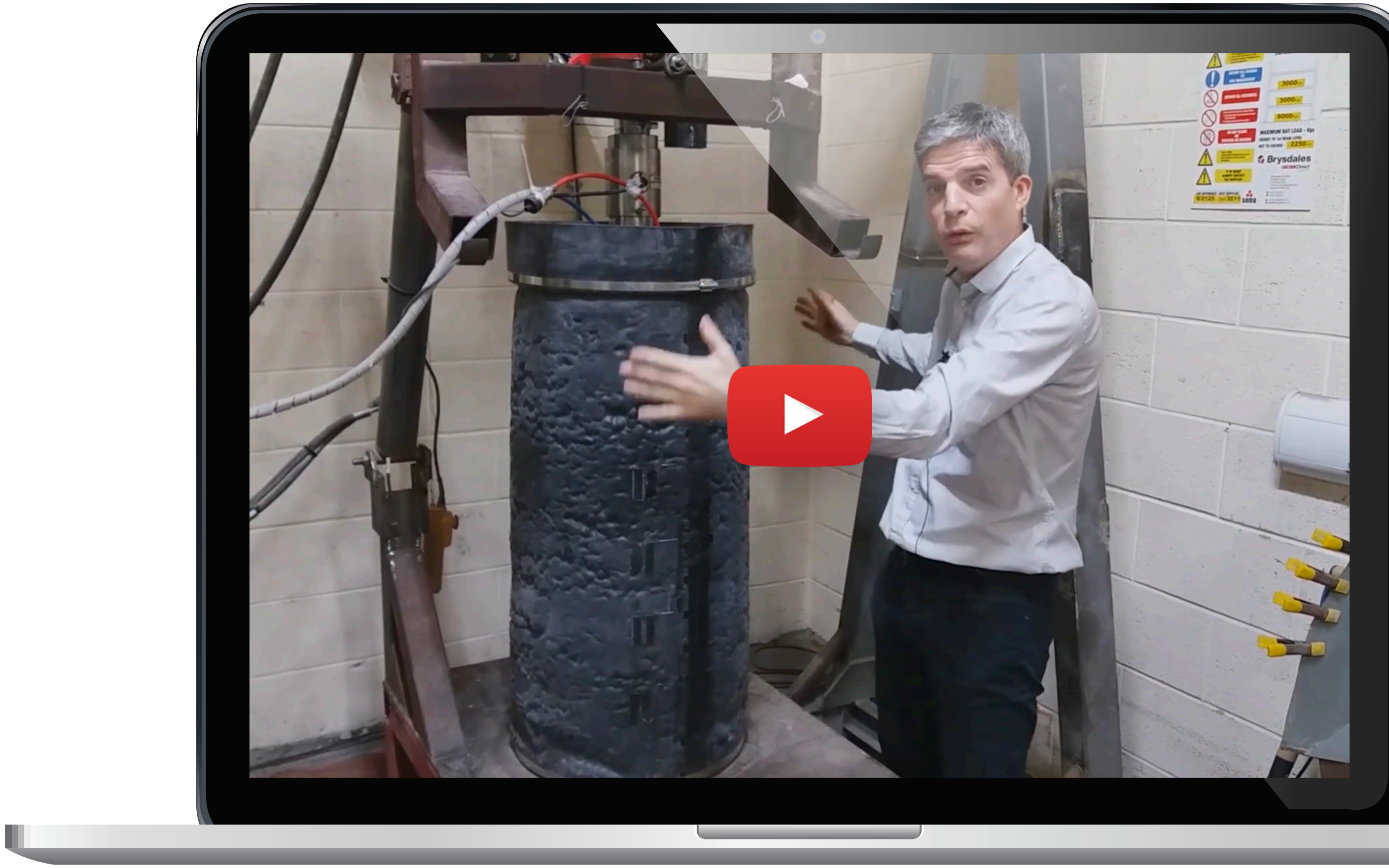

Verification of the T-Value Design Method through Field Trials

The T-Value design method has also been tested in the real world, with Tensar teaming up with the University of Saskatchewan in Canada to carry out full-scale plate load tests of a trial section of granular working platform on a clay subgrade.

Testing, using two 20t trucks as a reaction force, was carried out on 0.25m and 0.5m thick granular platforms, on sections with, and without, stabilising geogrid.

A 1m square plate was used to create a pressure bulb similar in size, and depth, to the one created by the track of a piling rig or crane. This, gave a more accurate assessment of ultimate (and safe) bearing capacity of the platform, compared with conventional tests using 0.3m or 0.6m diameter plates.

Testing, using two 20t trucks

To learn more about how we conducted our full scale trials on the Canada prairies, **watch our Ground Coffee video here.**

Tensar GROUND Coffee

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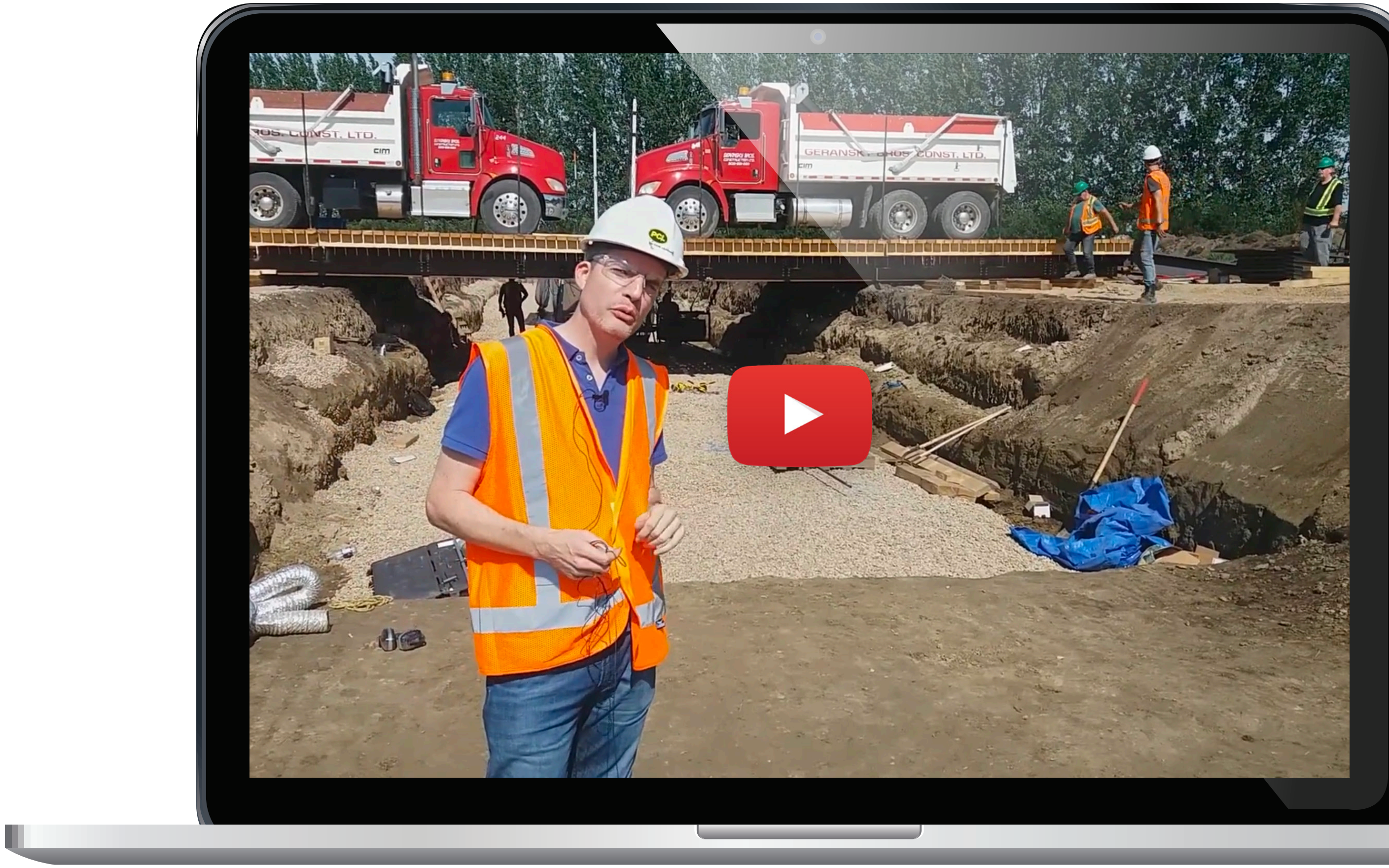

Applying in Practice, Acceptance and T-Value Calculator

Applying the T-Value Design Method in Practice at Beverley GO→

Applying the T-Value Design Method in Practice at Green Park GO→

Acceptance of the T-Value Design Method Testing GO→

Using the T-Value Calculator GO→

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Applying the T-Value Design Method in Practice at Beverley

The T-Value design method demonstrated that a working platform at Beverley Wastewater Treatment Works (WWTW) could be 350mm thinner than one built using non-stabilised aggregate, reducing construction time, costs and environmental impact.

Yorkshire Water was carrying out a £27m project to completely rebuild and modernise the WWTW.

Plans included construction of three new Final Settlement Tanks. Ground conditions were challenging, with made ground and thick deposits of very soft sandy clay and organic soils, with undrained shear strengths ranging from less than 5KPa to 10KPa. This meant the 20m diameter tanks would have to be supported on precast concrete driven piles, founded in chalk between 9m and 14m below ground level.

Download the full Case Study GO→

Applying the T-Value Design Method in Practice at Green Park Primary Academy

The T-Value design method enabled design and construction of two working platforms for the construction of Green Park Primary Academy in King's Lynn, when very weak ground meant standard approaches could not be used.

Norfolk County Council awarded the £8m design and build contract for the new academy to Cocksedge Building Contractors.

Consultant Richard Jackson was tasked with designing two working platforms, covering a total area of 2,150m2, to support a maximum load of 272kPa from the rig carrying out ground improvement of the underlying highly variable and very weak peat and clay soils. The platforms also provided access for the piling rig installing foundations for the school buildings.

However, the underlying soils' minimum undrained shear strength (Su) of 9kPa fell outside BR470 guidance, so Tensar was asked to provide a solution to allow piling operations to take place safely.

The T-Value design method produced the designs for the working platforms, one for the area with a minimum Su of 9kPa, and another, where the minimum Su was 25kPa.

Download the full Case Study GO→

Acceptance of the T-Value Design Method

The T-Value design method has been welcomed by industry, having been used on projects around the world since its introduction in 2019. Additionally, a number of academic papers have been published in industry journals, outlining the theory behind the method:

Ground Engineering Magazine
October | 2019
Bearing Capacity of geogrid-stabilised granular layer on clay.

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Canada Geotechnical Journal
April | 2019
Strength envelope of granular stabilsied by multi-axial geogrid in large traixal tests.

Read Now GO→

Institution of Civil Engineers
February | 2020
The bearing capacity of a granular layer on clay, Volume 173 Isuue 1.

Read Now GO→

13th Australian New Zealand Conference
April | 2019
Working platfoms for tracked palnt - BR470 guideline and revised approach to stabilisation design with multiaxial hexagonal geogrid.

Read Now GO→

W(m)

(m²)

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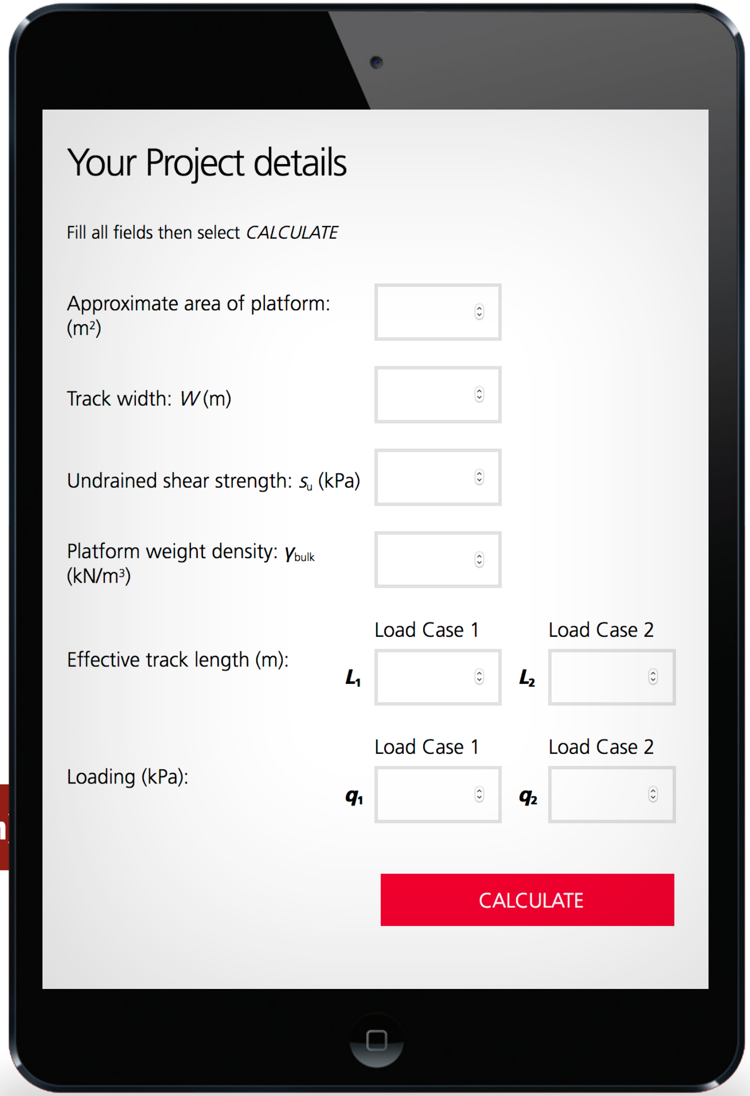
Use the T-Value Calculator to Begin Designing your Working Platform

Tensar's T-Value Calculator Link gives an illustration of the Tensar mechanically-stabilised platform thickness required for a working platform, based on the factors of safety recommended in BR470.

The calculator assumes the platform will be built using a well-graded and compacted granular fill (with a maximum particle size of 125mm) and the subgrade soil strength is known. It will also estimate the cost and time of constructing the platform, as well as the carbon savings.

ACCESS CALCULATOR



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Get in Touch

Contact Tensar for further information on T-Value or if you have any other working platform enquires.

academy@tensar.co.uk

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