Tensar®
Road Technology

SAVING TIME, MONEY AND CARBON
ON ROAD PROJECTS GLOBALLY

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ISSUE | 02

Why Britain's roads need **Joined-Up Thinking**

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STABLE FOOTING
Estimated £2m saving on the A556 project
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LOADS OF SUPPORT
A21 trunk road project
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Collaboration is key to Joined-Up Thinking

Tensar's recent successes on the UK's roads are not only down to the application of clever technical solutions but also the collaboration between infrastructure owners, designers, contractors, specialist sub-contractors and supplier.

This Joined-Up Thinking delivers pavement and structural designs that save significant costs, accelerate construction and extend the operating life of assets, minimising maintenance and whole life costs and reducing disruption on the country's busy roads, to keep the economy moving.

Welcome to Tensar Road Technology

In this issue, we look at the adoption of alternative designs for road pavements on a number of projects, how asphalt reinforcement can deliver more reliable highways, and the latest US Corps of Engineers research demonstrating the benefits of TriAx. We also take a look at how our TensarTech reinforced soil solutions can deliver cost-effective structures for highways projects. Enjoy the magazine!

Chris Buchanan
Director of Marketing and Product Management EH

WORKING WITH WHAT'S IN FRONT OF YOU

Removing barriers to adopting innovation, and ensuring standards keep pace with technical developments, is essential if we are to meet future highways infrastructure needs.

£27bn Set to be spent on UK road building over the next five years

In March 2020, just before the coronavirus pandemic, the UK government announced a £27bn road building programme over the next five years, with spending on upgrading the existing network, as well as construction of new routes.

While it is unclear how much of an impact COVID-19 will have on future spending, the UK is not alone in continuing to invest in its road networks. However, coupled with this spend is a drive to deliver safe infrastructure efficiently, with schemes that offer value for money (in terms of both construction and whole life costs) and minimise their environmental impact.

Meeting these targets essentially boils down to mitigating risk – a large proportion of which lies in the ground. Designing to actual ground conditions can deliver more appropriate solutions, mitigate risks and ultimately add more value. This does not necessarily mean spending more but requires a change of approach and wider acceptance of 'alternative' designs. Inevitably, design codes and standards lag behind technological advances but in some sectors, they are now many years behind.

Geogrids in road pavement design

Aggregate layers mechanically-stabilised with Tensar geogrid have been shown to help to delay early failure of flexible pavements, reducing asphalt rutting and cracking and making roads safer, for longer. However, while Tensar geogrids have been used on thousands of road projects around the world for the past 40 years, they are often viewed as alternative solutions because they are not specified in design standards.

This is despite a wealth of empirical evidence and independently-verified research commissioned by Tensar demonstrating the performance benefits of incorporating our geogrids in flexible pavements, including research carried out by the US Corps of Engineers (see p7)

Fortunately, clients are beginning to realise that sticking to normal practice is not going to help meet infrastructure plans. Highways England, for example, is actively engaging and collaborating with its supply chain to explore how it can work with specialists to tap into new techniques and approaches.

> At Tensar, we believe building better relationships is at the heart of infrastructure's future success.

Encouraging engagement, collaboration and knowledge sharing, and providing forums to allow the supply chain to match its expertise with clients' needs, are all essential for delivering reliable, robust and safe infrastructure for future generations.

REF: 365 | *Click here to download the full case study*

Stable footing

Using geogrid to mechanically stabilise founding aggregate layers saved an estimated £2m on the A556 improvement scheme in Cheshire.

An estimated 51,000 vehicles, including about 5,000 lorries, use the A556 between the M6 and the M56 every day. The route, linking south Manchester with commuter towns, including Altrincham, and Manchester Airport, has multiple junctions with local roads and is often congested, with a high number of serious accidents in the past few years. Highways England's A556 Knutsford to Bowden Improvement Scheme aims to solve these problems, with construction of an offline 7.5km long dual carriageway to the west of the A556 between the M6 and the M56.

Designed to give a capacity greater than 80M Equivalent Standard Axle Loads (ESALs), the road pavement comprises a 250mm thick unbound granular capping layer with two, 150mm thick layers of cement bound granular material (CBGM) above and, finally, 160-180mm of asphalt.

Dealing with challenging ground

The highly variable ground conditions along the route were challenging, from very dense granular material to thick layers of very soft clay with a CBR of between 1.5% and 2%. The road design required a minimum CBR of 2.5% and principal contractor Costain needed to deal with the soft clay on two 300m long sections. After rejecting lime stabilisation and 'dig and replace', on grounds of cost and timescales, Costain chose a solution from Tensar to stiffen the unbound capping layer using TriAx geogrid.

The TriAx interlocks with the aggregate under trafficking, confining lateral movement of the particles to create a mechanically stabilised layer. This will reduce rutting and cracking of the asphalt and help prevent moisture and contaminants entering and weakening the structure, increasing pavement life.

> "We found the Tensar TriAx solution to be a faster, more simple and cost-effective alternative to lime stabilisation or dig and replace, plus it was far safer than the other options."

Anthony Mackenzie
Senior Engineer, Costain

CASE STUDY

£2m Estimated project cost savings

Using TriAx saved an estimated £2m in project costs, compared with dig and replace. This also meant a potential 10,000 lorry movements were avoided.

Once the new road was opened, the original A556 was narrowed to a single carriageway and improved provision made for pedestrians, cyclists and horse riders, as part of a 'de-trunking' project.

Tensar TriAx the clear winner

The Tensar mechanically stabilised layer exceeded the requirements for Foundation Class 1 by around 30%, improving the performance of the entire pavement structure.

In numbers:

Road length	7.5km
Length of road supported by Tensar TriAx	600m
Tensar TriAx used	30,000m^2
Increase in bearing capacity at top of granular layer	40%
Construction savings	£2m

A different way of thinking

Chemical stabilisation is not the only cost-effective alternative to 'dig and replace' for delivering a robust and long-lasting roads network, says Tensar Senior Product Manager Jonathan Cook.

Two of the central pillars of the UK Government's Road Investment Strategy are to reduce maintenance costs by 30-50% and to reduce the environmental impact of roads, including their construction.

There are a number of different – and greener - approaches to increase bearing capacity, that are faster and more cost-effective than traditional 'dig and replace', including chemical stabilisation and stabilisation geogrids.

While chemical stabilisation – using lime, cement and other hydraulic binders – can reduce environmental impact by reducing the amount of material needing to be disposed of, and the amount of imported material required (with the associated reduction in lorry movements), it has its limitations.

First, not all soils can be stabilised chemically – the method is most effective on high plasticity clays, silts and fine sands – and soils containing sulphates can react negatively to the binder. Testing is needed to confirm suitability and treated ground needs to be left to cure for a few days. There is also a risk of treated soil deteriorating, if there are frequent wet-dry cycles.

Additionally, heavy stabilisation plant and equipment can struggle on the softest soils and treatment cannot be carried out in heavy rain.

Faster, simpler and more cost-effective

Stabilisation geogrids installed in a capping layer or in the unbound layers of a road pavement, on the other hand, are faster, simpler and more cost-effective. They can be installed in any soil type, by hand, in any weather. Plus, there is no 'curing time': construction can proceed immediately.

Geogrids can reduce the amount of unsuitable material that has to be excavated and, in some cases, remove that need entirely. They can also be used with recycled, site-won marginal fills and help reduce the thickness of aggregate layers, while improving overall performance.

This can help reduce the maintenance and repair burden, further strengthening the argument that geogrids should be at the heart of helping to meet the drive for greener, sustainable roads that deliver value for money.

Jonathan Cook
Senior Product Manager

Tensar TriAx performs strongly in full-scale trafficking trials

Research by the US Corps of Engineers has shown aggregate layers stabilised with Tensar TriAx deliver significant performance benefits to flexible road pavements, reducing surface rutting by up to 44%, compared with non-stabilised aggregate.

Researchers confirmed that "incorporation of a multi-axial geogrid in a flexible pavement base course provides a significant structural benefit."

Results also demonstrated that incorporating Tensar TriAx geogrids could cut construction time and costs by up to 19% and reduce carbon emissions by a quarter, compared with a thicker, non-stabilised pavement.

The full-scale accelerated pavement testing compared the performance of three pavement sections: a control of 100mm of asphalt and 200mm of crushed limestone and two sections of 75mm of asphalt and 150mm of aggregate, each with a layer of different grade of geogrid. The underlying subgrade was a 'competent' clay with a CBR of 6%.

> "Incorporation of a multi-axial geogrid in a flexible pavement base course provides a significant structural benefit."
>
> **US Corps of Engineers**

800,000 ESALs

The pavement sections were subjected to more than 800,000 Equivalent Standard Axle Loads (ESALs)

Rut depth was measured throughout testing. Sections incorporating TriAx performed significantly better than the control, despite being more than 25% thinner.

Total surface rutting in the non-stabilised control section was 16mm, while maximum rut depth in the geogrid stabilised sections was just 8mm. All of the deformation was in the asphalt layer, demonstrating that the geogrids' stabilisation effect provided additional support and protected the subgrade.

Best performance

Standard bitumen tack coats have delivered the best performance in geogrid-reinforced asphalt tests.

Tensar geogrid-reinforced asphalt systems installed with standard bitumen tack coats outperformed those using higher spray rates, as well as those using polymer-modified bitumen bond coats, in independent laboratory tests.

"Results show using a 1.1l/m^2 of tack coat with asphalt geogrid reinforcement is more effective than using a 2l/m^2 spray rate and more effective than a polymer-modified bitumen bond coat, which could, in fact, affect performance, as well as being more expensive," says Tensar Asphalt Reinforcement Manager Tony Roe.

Aecom's Pavement Design and Asset Management team was commissioned by road maintenance specialist Foster Contracting to assess the effect and performance of Tensar's Glasstex composite glass yarn grid and non-woven paving fabric on asphalt systems, incorporating either bond or tack coats.

Glasstex acts as a Stress Absorbing Membrane Interlayer and a moisture barrier, providing asphalt reinforcement, stress relief and sealing, giving road pavements a longer operational life, reducing reflective cracking and reducing maintenance requirements.

Modified wheel track testing applied a load of 1.5kN on the samples, which comprised a 50mm thick stone mastic asphalt with Glasstex, overlaying a 50mm thick concrete base with a 3mm-4mm width notch to simulate a joint. Control samples, without Glasstex, were also tested. The number of passes it took to induce cracks in the asphalt were recorded, to give an assessment of performance.

"The first phase of testing assessed Glasstex with a 1.1l/m^2 160/220 paving grade bitumen tack coat and a 1.1l/m^2 polymer-modified bitumen bond coat," explained Foster Contracting Director Ray Wicks. "The second phase assessed Glasstex using different amounts of the same tack and bond coats – 1.1l/m^2 and 2l/m^2, respectively.

> "Tests demonstrated that Glasstex improves resistance to reflective cracking, by slowing upward crack propagation from the concrete to the asphalt – samples incorporating Glasstex exhibited top-down cracking failures primarily. However, those samples without Glasstex showed bottom-up cracking; in other words, there was no protection against reflective cracking."
>
> **Ray Wicks**
> Director, Foster Contracting

Roe adds that while polymer-modified bitumen increases tensile bond strength of the interlayer, compared with a straight bitumen tack coat, increasing the amount of bond or tack coat in the test samples actually led to earlier failure in some cases.

"While larger spray rates of 2l/m^2 and the use of polymer-modified bitumen are sometimes recommended when installing asphalt reinforcement geogrids, these results demonstrate a 1.1l/m^2 tack coat, as specified in BS EN 15381:2008 *Geotextiles and geotextile-related products. Characteristics required for use in pavements and asphalt overlays*, is the optimum spray rate to maximise performance."

Smart solution

A Stress Absorbing Membrane Interlayer delivered stronger, safer and more reliable running lanes for the M3 smart motorway project in Surrey.

More than 130,000 vehicles use the M3 between Junctions 2 (Thorpe and the M25) and 4a (Farnborough) every day.

As part of Highways England's smart motorways programme, the capacity of this congested three lane section has been increased, with hard shoulders converted to an additional running lane. The aim was to relieve congestion, smooth traffic flow and to improve journey reliability.

Asphalt surfacing contractor Tarmac, working for Principal Contractor Balfour Beatty, carried out structural resurfacing of the carriageway as part of the project.

> "The road was in poor condition, the result of reflective cracking of the asphalt, due to movement of the underlying layers that were made up of both lean mix concrete and bituminous road base."
>
> **Barrie Farquhar**
> Tarmac Project Manager

300,000m²

of Glasstex was laid along a 26km stretch of the M3

Repairs were needed to strengthen the road and to prevent further cracking, which could have led to water ingress and further deterioration of the concrete. Highways England needed a pavement solution that would reduce initial costs, increase service life, as well as minimise maintenance and future disruption.

Consultant Aecom had specified asphalt reinforcement in the pavement design. Tarmac, subcontractor Foster Contracting and Tensar proposed using a Glasstex Stress Absorbing Membrane Interlayer (SAMI) solution, while supporting the required departure from the standard process.

A total of 300,000m² of Tensar's Glasstex composite was laid by Foster Contracting, on both the northbound and southbound carriageways, along the 26km stretch of road (ie a total of 52km).

A straight run bitumen 160/220 bond coat was used to adhere the Glasstex to the underlying pavement structure.

An added benefit of installing a SAMI Glasstex solution on motorway projects is speed. Work typically has to be carried out at night, which obviously limits the amount of time available. Using Glasstex means the reconstruction depth is far shallower: on the M3 it was just 120mm to 150mm, rather than a minimum 360mm with a standard approach, which obviously saved time and, as a result, construction costs.

Structural solutions

Load-bearing reinforced soil walls can cut construction costs by up to 75% and halve build times compared with traditional solutions, while being robust and low-maintenance, says Tensar's Senior Product & Application Technology Manager Craig Roberts.

Reinforced (or mechanically-stabilised) soil is becoming a standard way of forming cost-effective walls and bridge abutments on highways, instead of the more traditional options that frequently involve piling and reinforced concrete.

The approach uses layers of geogrid to reinforce soil, increasing bearing capacity and increasing resistance to differential settlement. Reinforced soil structures have lower bearing pressures, which can eliminate the need for expensive foundations.

> Geogrid layers are mechanically connected to a range of facings, including modular blocks, concrete panels, gabions and crib walls, depending on the aesthetic requirements of the project. This creates strong, durable structures, requiring minimal maintenance, with design lives of up to 120 years, that are covered by the relevant HAPAS BBA certificates.

In many cases, all of a bridge's bank seat loading can be carried by a reinforced soil abutment. For example, Tensar has designed temporary and permanent structures using its TensarTech systems to support loads of more than 500kN/m. And, if piling is needed, then the piles can be incorporated easily into the abutment fill.

A big advantage of using Tensar's durable HDPE geogrids is that they work with a huge range of materials, including non-standard fills (such as selected site-won fill) and waste products such as pulverised fuel ash. This versatility can save time and money on projects, as well as reducing their carbon footprint.

Craig Roberts
Senior Product & Application Technology Manager

REF: **374** | *Click here to download the full case study*

CASE STUDY

Loads of support

The TensarTech TW3 modular block reinforced soil system was the ideal solution for building the load bearing bridge abutments and wing walls for overbridges at two new grade separated junctions between Tonbridge and Pembury on the A21 in Kent.

Tensar worked with WSP to design the retaining structures for main contractor Balfour Beatty. The abutments were built using Department of Transport Type 6I/J aggregate, designed to meet bank seat loads of up to 566kN/m and to resist horizontal loads of up to 54kN.

TW3 was used to build a total of 194 linear metres of abutments and 80 linear metres of wing walls up to 7.6m high. It was also used to build a 60m long, 3.6m high retaining wall on the route.

Minimal disruption

Aside from technical performance, Balfour Beatty chose TW3 because traffic flow had to be maintained throughout the works. TW3's modularity meant it could be built in the limited space available, without heavy lifting equipment or propping, and with minimal disruption to road users.

Let's talk

Tensar® Road Technology

Like to find out more about Tensar Road Technology and what it could do for your next project?

Would you like to discuss a topic relating to the highways industry?

Or have you got an idea for something you'd like to see in the next issue?

We'd like to hear from you!

Your Tensar Highways Team, Rajit and Tony are here to help!

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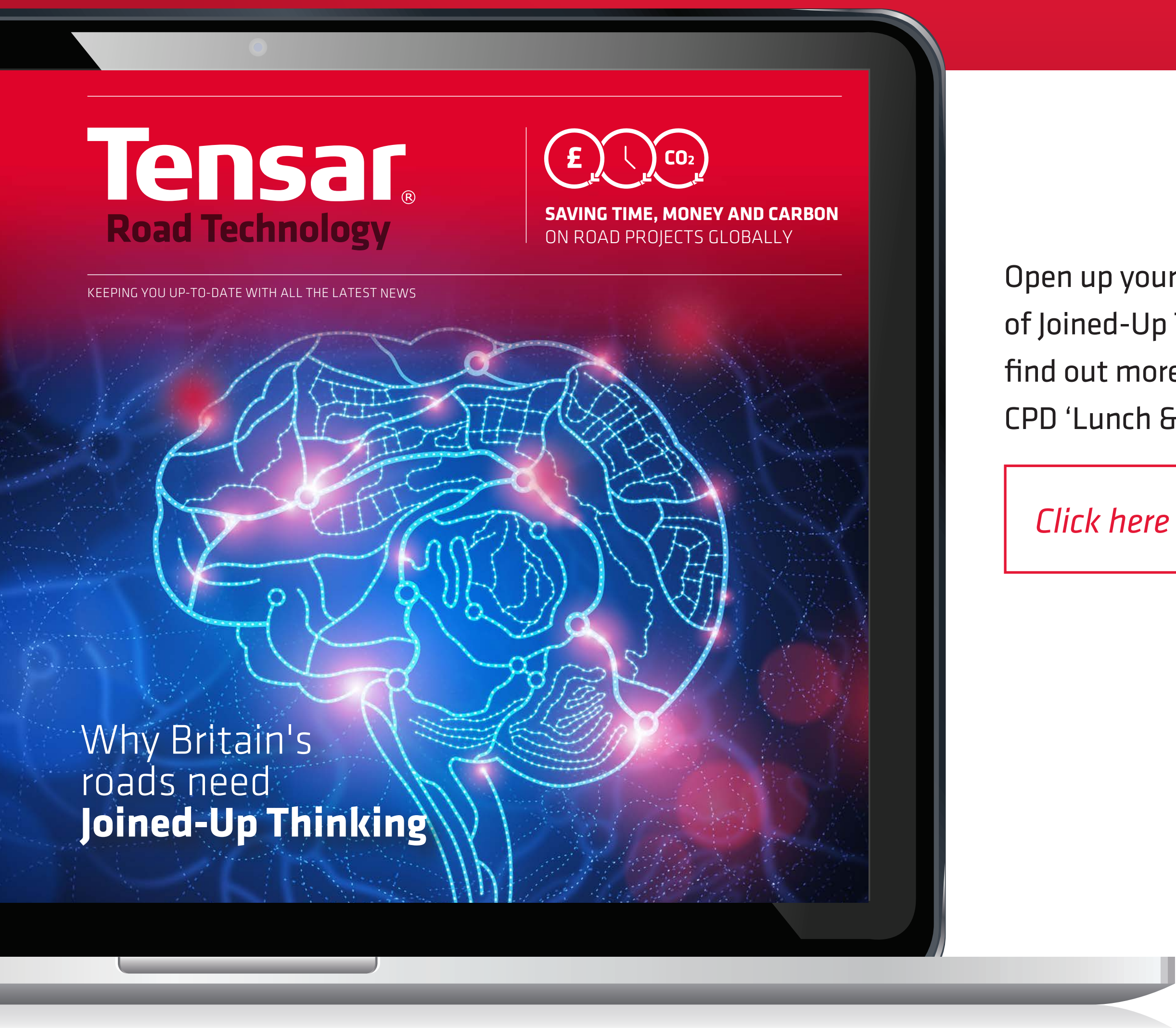

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