

PLOTTING THE ROAD MAP FOR PERFORMANCE SPECIFICATIONS

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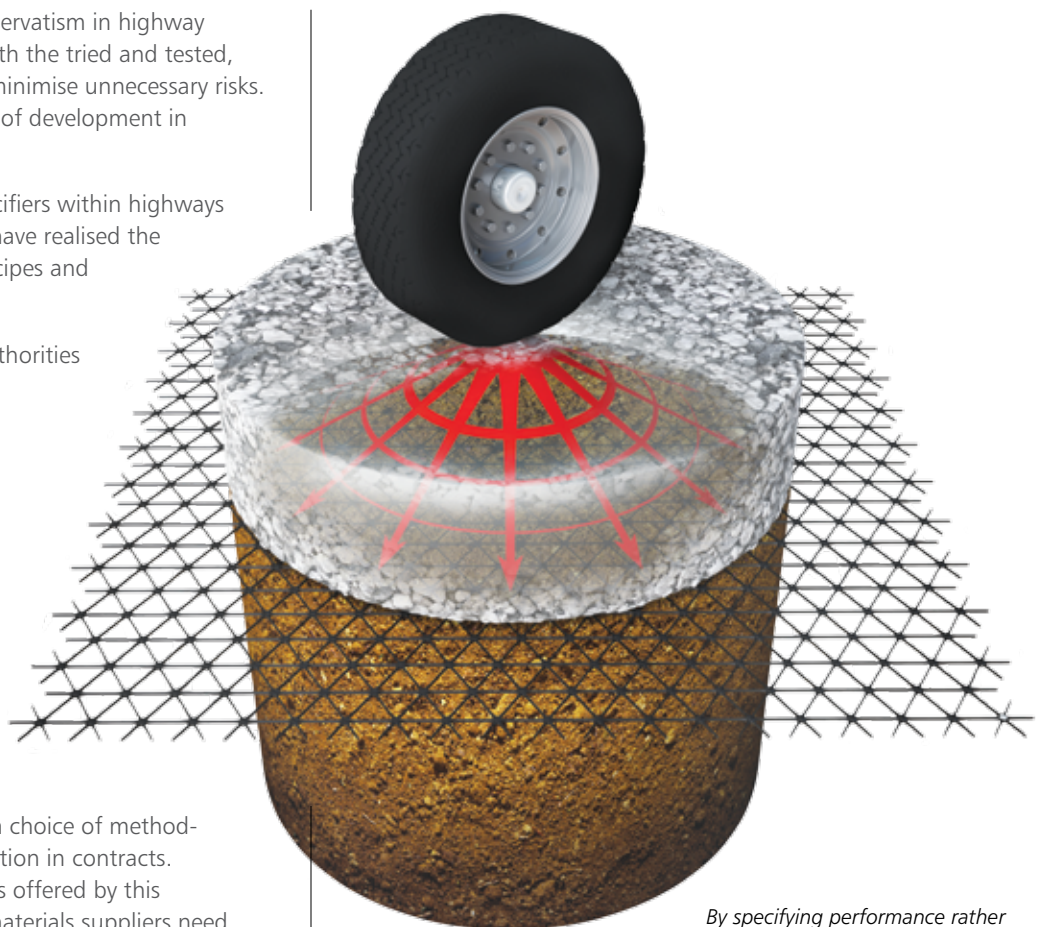
Slowly but surely, specification by performance is becoming a more accepted method for construction by highways agencies both in the UK and internationally. The results promise much needed innovation and significant economic and environmental benefits. But how should contractors and suppliers be adapting to changing client demands? Tracing the route of changing specification practice tells us that reliance on laboratory-based testing of materials cannot show how materials perform under real life site conditions.

Civil engineering's reputation for conservatism in highway construction has always felt secure with the tried and tested, aiming to repeat past successes and minimise unnecessary risks. This has resulted in a near static state of development in pavement design.

Yet, increasingly, forward looking specifiers within highways agencies – the client organisations – have realised the limitations of traditional pavement recipes and method-based practices.

To encourage innovation, highway authorities have displayed a willingness to adopt performance specification as a model, a trend that is being accelerated internationally. Some States in North America have introduced pioneering guidelines and the UK and Europe are not far behind with documents giving advice on broadening the scope of pavement design.

As a result of clients' demands for cost-savings and the need for a step change on minimising environmental impact, contractors and suppliers increasingly encounter a choice of method-based or performance-based specification in contracts. To make the most of the opportunities offered by this unstoppable trend, contractors and materials suppliers need to adapt to changing client requirements in the way pavements are designed and built.



By specifying performance rather than properties of this mechanically stabilised layer incorporating Tensar TriAx™ the engineer is more assured of achieving the designed outcome.

The method-based recipe book

The currently accepted method-based specification is a 'recipe book' approach for materials, dimensions and installation requirements for most aspects of pavement construction. This approach has imposed consistency and protected construction standards in the past. However, there is a need now to 'drive down costs' as the Highways Agency in England expresses it.

To continue the recipe metaphor – using a set of pre-dictated ingredients and methods does not necessarily guarantee the tastiest cake available. In their Performance Specifications Strategic Roadmap: a Vision for the Future (2004)¹ the US Federal Highways Administration points out that method-based specification 'could not deal with rewarding a contractor for "better-than-minimum practice";' and '...could not consistently deal with work that was outside the bounds of "reasonably close conformance".' Method specification 'inhibited innovation' and there is no incentive for a project manager to consider 'departures from standards' and 'departures from procedure'.



For a new link road built by Costain over marshland near Wakefield, the performance of Tensar TriAx™ demonstrated clear performance advantages

Specification by performance

In contrast, performance specification sets out 'key performance indicators' (KPIs) for the highway construction. The contracting engineers have to demonstrate that the method and materials satisfy these agreed KPIs, for example, foundation surface modulus, traffic induced deformation, whole life cost, design life and, naturally, the carbon footprint.

If the proposed construction method lies outside the standard recipe, then performance data based on in-situ performance testing by accredited third parties and actual on-site trials must be used to verify the expectations of the design or method under scrutiny, (commonly pavement layer surface modulus and performance under construction traffic loading).

In the UK, the Highways Efficiency Liaison Group² is a unique industry wide group which has designed a Toolkit³ to enable local authorities to identify, measure and justify service improvements and efficiency gains in highways and transportation services. One such approach is the Highways Agency's Interim Advice Note [IAN 73/09] which covers the design of road pavement foundations.

IAN 73/09 allows Restricted Foundation Designs which a contractor may follow using set chart-based pavement design procedures. Such method-based specifications may still be followed if it is appropriate to the project. The other choice is Performance Designs where the onus is on the contractor to design the pavement layers to obtain cost or sustainability benefits. Important features of the Performance Designs in IAN 73/09 include:

'4.1 The main objectives for developing Performance Designs for Foundations and the Performance Related Specification for Foundations are:

- to facilitate the efficient use of a wide range of resources, incorporating natural, secondary and recycled materials as both binders and aggregates;
- to provide some assurance that the material performance assumptions made during the design process are being, or are likely to be, achieved;
- to recognise the structural contribution of improved foundation performance and hence permit the adjustment in thickness of the pavement layers above.

4.2 The philosophy of Performance Design relies on performance testing to confirm the physical properties that are critical to the design process. To ensure parity between different materials and minimise unnecessary exclusion, this evaluation is based on a common method of assessment.'

¹ Performance Specifications Strategic Roadmap: a Vision for the Future (2004)¹ the US Federal Highways Administration

² Promoting Improvement and Efficiency in Local Highways Services: Highways Efficiency Liaison Group (HELG) – October 2008.

³ Managing Down Costs (MDC) Toolkit

Experience of performance success

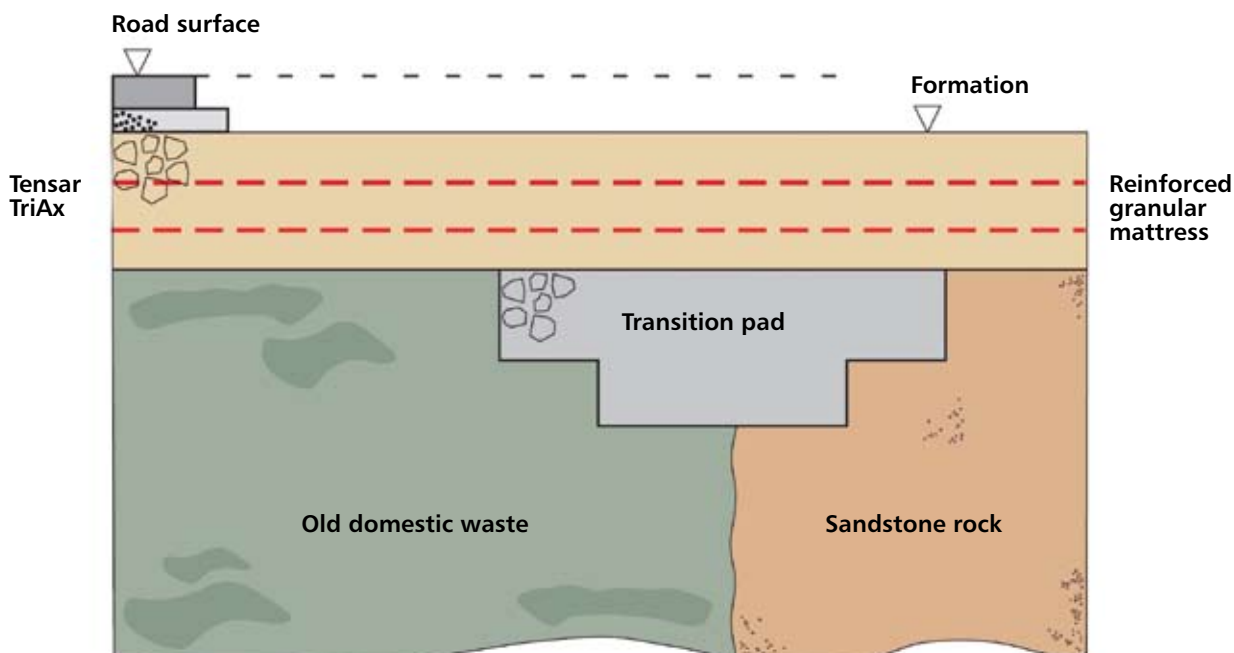
Development of performance-based specifications is an evolving process, where mechanistic designs may be performed and, probably, incorporating a certain amount of empirical evaluation of what works well and what doesn't. The US FHWA has been developing and advising on this practice for many years, and has gained experience on what is successful in practice.

Performance specifications have already demonstrated benefits in the USA:

*'The State of Wisconsin experienced a 36 percent improvement in highway ride quality on pavement projects using performance specifications. Comparing lifecycle costs on these same projects, Wisconsin saw about a 10 percent saving.'*⁴

Published studies in the UK also explore the potential of performance specification. Arup's report for the Highways Agency - 'Development of Performance Specifications for Earthworks (2005)' - clearly outlines potential advantages against both method specification and end-product specification. The US FHWA⁵ and the EU (2005)⁶ have both given impetus to the trend towards performance specification and published documents on the benefits of performance specifications, whether in highways construction or more generally in project specification and procurement.

A junction extension constructed by BBCEL at the Melsonby turn off from the A66 near Scotch Corner illustrates how a Tensar TriAx™ geogrid solution demonstrated its ability to control differential settlement over an old landfill pit.



⁴ http://cpr.ca.gov/CPR_Report/Issues_and_Recommendations/Chapter_4_Infrastructure/INF02.html California State DoT

⁵ Performance Specifications Strategic Roadmap: A Vision for the Future: Spring (2004) US Federal Highways Administration

⁶ Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004

This illustration shows a cross section through the construction showing the landfill pit. The increased stiffness of the mechanically stabilised layer incorporating Tensar TriAx™ reduced differential settlement.

The value to the contractor

The value of performance design to the contractor is that it can use cost-effective resources of variable quality, as long as the requisite performance is confirmed by realistic site testing. In this way, the contractor can also meet carbon footprint and environmental impact KPIs for a project, whilst preserving the over-riding need of achieving a profit.

Within contracts framed around performance specifications, the contractor has the latitude to use the accumulated experience of its Engineers to solve a problem, such as pavement foundation over weak or variable ground conditions, with the most appropriate design and materials for that location. This encourages creative highway engineering as well as providing economic and sustainability improvements to the benefit of contractor and client.

Balfour Beatty Civil Engineering (BBCEL) has been pioneering performance specification highway contracts in the UK and John Ferguson, the BBCEL Chief Materials Engineer, points out that it offers more freedom for obtaining clear environmental benefits: *“Performance specification construction offers the contractor far greater scope for value engineering of pavements with secondary recycled and locally won resources not used as primary high quality end product”*.

The challenges ahead

Performance specification provides new challenges both to a contractor and a pavement materials supplier and it encourages their working in tandem. To control risk, the contractor will want a site performance demonstration of say, a pavement foundation, before building a complete road. If the supplier supports his design and materials by credible in-situ performance data and experience, the contractor may be confident that the on-site performance trial risk is effectively shared between the parties.

The supplier who wishes to be included in performance specifications will also have to make considerable investment into accredited third-party evidence for design and materials as a minimum entry standard to gaining contracts. As a contribution to the partnership, this approach is essential to operating under performance specification guidelines.

While materials such as geogrids must meet the quality tests required by CE conformance and BS test requirements, it must be remembered that these are only base level quality tests of certain physical parameters. The tests do not measure what happens when the materials are put under load in the ground. Only actual in-situ performance trials can truly demonstrate how the combined design and material meet the inherent variability of ground conditions.



Extended trafficking testing performance trials at the Transport Research Laboratory are an essential part of demonstrating the in-ground performance of geogrids such as Tensar TriAx™.

Time and investment in performance

To demonstrate the scale of typical performance testing requirements of new products, Tensar International has invested in 6 years of development for its new TriAx™ geogrid. This includes five separate performance trials at the Transport Research Laboratory, two at the University of Nottingham Pavement Research Centre and two bearing capacity trials at the Building Research Establishment and this has been coupled with numerous field demonstrations with selected contractors on actual projects which gave further insight. Additionally, extensive third party and in-house laboratory testing and certification has been undertaken, backed by full professional indemnity warranties for its 'design partner' appointments.

Conclusions

Performance specifications in highway construction encourage a contractual environment that stimulates innovation and obtains the best value results based on engineering experience and insight, rather than a formulaic approach. With a highways client focused on performance, best value solutions will drive progress in economic and environmental advances.

Innovation in reducing lifetime costs of our infrastructure network will become key to future pavement construction, from foundation through to the wearing course. Adoption of performance specification as a usual working method will allow innovation to transform highways industry practices.

It is also highly important, therefore that the client – the Highways Agency, Local Authority or other – is encouraged to extend performance specification and design practice to all appropriate projects through its continued adoption by contractors and their materials suppliers. As the benefits become clearer, and procedures and key guidelines become more standardised, the performance approach will attract more adherents.

Few successful revolutions happen overnight, and considerable time and investment spent in continued accumulation of materials and design performance data will be essential to bring meaningful and credible contributions to the contract table. That progressive contractors and clients recognise this is rapidly becoming more apparent.

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