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Track & Infrastructure

Presto Geosystems

Ballast Stabilisation Using Geocells: The Often-Overlooked Importance of Junction Efficiency as a Key Design Consideration

A significant number of research studies have been carried out to investigate the benefits of using geocells in railway trackbed applications.

Combined with an ever-expanding list of successful projects from around the world, the benefits of using geocells in rail ballast stabilisation is well-documented. Rail operators understand that durable track geometry starts with a solid foundation, and geocells have emerged as a powerful value engineering tool for reinforcing ballast and sub-ballast layers while optimising layer thicknesses.

Many practitioners may not be aware of the critical role that geocell junctions (both mechanical and internal) play in ensuring that the installed system performs in a uniform and consistent manner. In trackbed stabilisation applications, non-uniform junction performance can lead to differential settlement and localised subsidence – which in turn can lead to serviceability issues and a reduction in overall design life. In essence, poor junction performance can nullify all the intended benefits of a geocell system.

This article will succinctly discuss the different types of junctions present in geocell systems, failure mechanisms and test methods, and the concept of junction efficiency as a performance parameter.

Types of Geocell Junctions

There are two types of junctions present in any geocell system: internal junctions, the factory-welded seams that create the interior cells of the panel, located within the body of a geocell panel; and mechanical

junctions located around the perimeter of an individual panel, formed during installation when adjacent panels are connected in the field, creating mechanically joined cells along panel joints. Since a primary mechanism by which geocells provide benefit is through lateral confinement of the infill, it is vital that both types of junctions remain intact during construction and throughout the design life of a project.

Junction Performance: Failure Mechanisms, Current Test Methods

Dating back to original research performed by the U.S. Army Corps of Engineers in early geocell development, much of the focus on junction performance was limited to peel strength of these internal junctions, with less consideration for mechanical junctions or other potential modes of junction failure. International Standard ISO 13426-1, "Strength of Internal Structural Junctions – Part 1: Geocells", presents standard test methods for evaluating several possible failure mechanisms for geocell junctions, including failure

GEOWEB® Geocell Product Series	Cell Depth Inches (mm)	Internal Junction Efficiency	Mechanical Junction Efficiency
20V3, 30V3, 40V3	3 (75)	>100%	>100%
20V4, 30V4, 40V4	4 (100)	>100%	>100%
20V6, 30V6, 40V6	6 (150)	>100%	>100%
20V8, 30V8, 40V8	8 (200)	>100%	>100%

in shear, peeling and cell splitting. What is lacking in ISO 13426-1 and similar standard test methods is a way to relate these failure mechanisms to the tensile characteristics of the cell wall itself.

Geocells are comprised of single strips of high-density polyethylene (HDPE) joined together. From a structural integrity perspective, these junctions should be expected to perform at a level that is equal to or better than that of the cell wall itself to ensure uniform and consistent performance. This is where the concept of junction efficiency comes in.

What Is Junction Efficiency?

Junction efficiency is a ratio (typically presented as a percentage) accounting for all three primary modes of potential junction failure (shear, peeling, splitting), and compares measured junction strength values to the tensile properties of the perforated cell wall. Separate values must be determined for internal and mechanical junctions.

In the case of mechanical junctions, the type of connection must be specified, with laboratory samples consistent with in-field installations. If the mechanical junctions will use staples, then representative laboratory tests must incorporate all relevant aspects of the stapling method, including material (stainless steel vs. aluminium), gauge, minimum number per junction and vertical/horizontal spacing necessary to achieve junction performance requirements. Similarly, if cable ties or two-piece connectors are the recommended connection device, then their break strength, material composition, durability, length and assembly instructions must be specified and tested. In the case of GEOWEB® geocells, mechanical junctions utilise Presto Geosystems's patented ATRA® Key. ATRA Keys are simple to use and provide consistent, reliable mechanical junction performance for the life of the project. As shown in the table below, GEOWEB geocells facilitate junction efficiencies in excess of 100% for both internal and mechanical junctions, offering robust protection against the primary modes of junction failure.

Presto Geosystems

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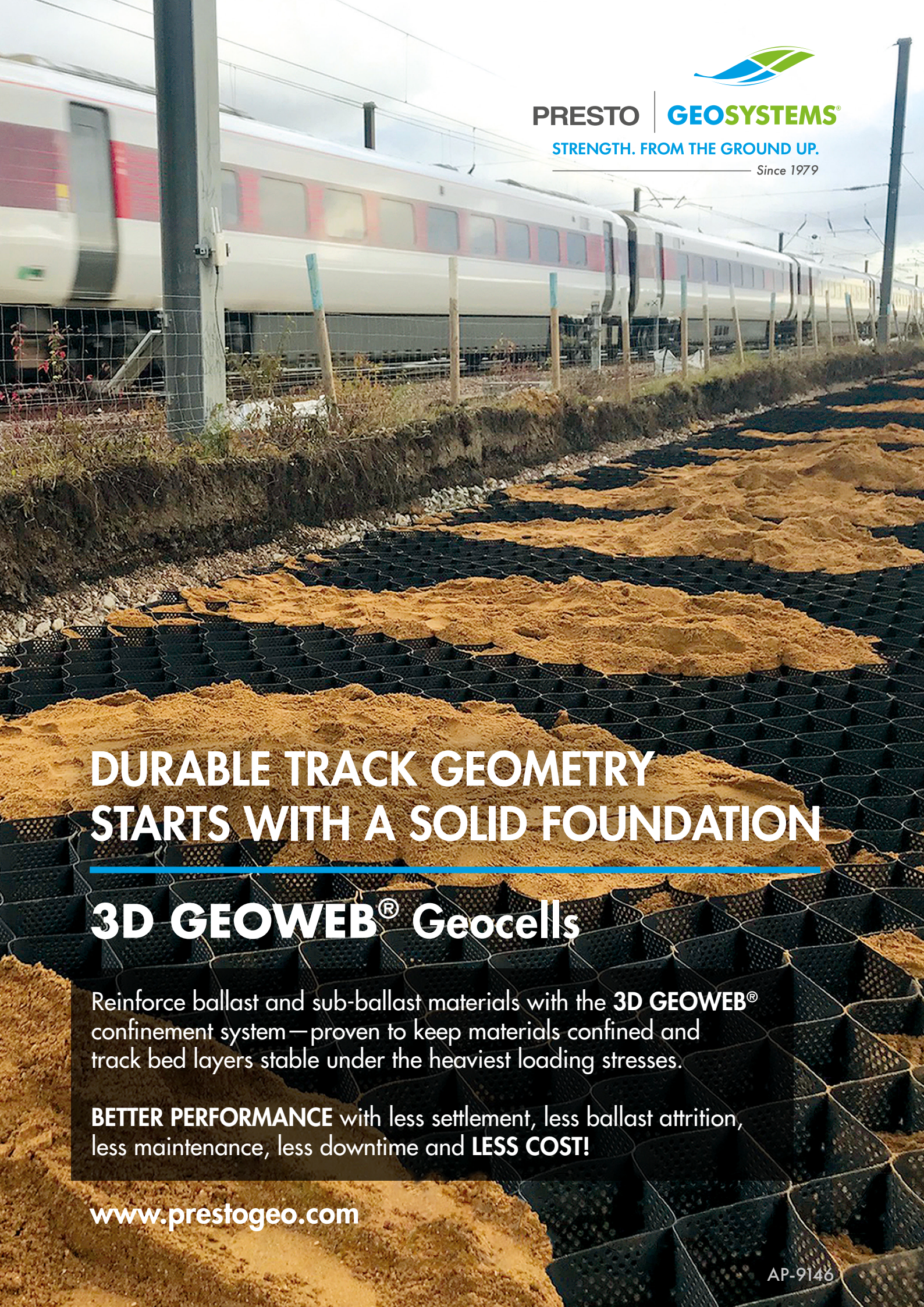

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AP-9146