Title: PERFORMANCE ASSESSMENT OF GEOCELL REINFORCED ROAD PAVEMENT

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ABSTRACT

Due to rapid population growth and industrial expansion, pavements are increasingly being constructed on weak subgrades that are prone to uneven settlement, low shear strength, and high compressibility, leading to premature pavement failures. In response to these challenges, geocells have become a widely adopted method for soil stabilization.

This study aims to thoroughly examine the performance of geocell-reinforced pavement and discern the key factors affecting its performance through a combined approach of experimental and numerical analyses. It begins with large-scale model testing of reinforced and unreinforced sections, followed by numerical analysis conducted using the three-dimensional finite element program PLAXIS 3D. This study involved systematic, large-scale instrumented model tests on both geocell-reinforced and unreinforced pavements under various loading conditions. The tests were conducted on pavements built over clayey and sandy subgrade soils, with variations in weld spacing (SW = 330 mm, 356 mm, and 445 mm) and geocell height (H = 75 mm, 100 mm, 150 mm, and 200 mm). Additionally, a finite element model delves into the effects of various parameters on the performance of reinforced pavement, including base material and diameter of wheel contact area. The responses studied were stress distribution in different pavement layers, induced strains in geocell walls, and settlement characteristics. Based on the outcomes obtained from experimental and numerical analyses, a field investigation has been carried out over problematic soils in Dholera, Gujarat, India to understand the effect of geocell in real-field conditions. Ten new pavement sections were constructed at Dholera, comprising two unreinforced test sections and eight reinforced sections with various geocell configurations over untreated and lime-treated subgrades. The performance of these sections was assessed using plate

load tests and a falling weight deflectometer. Finally, based on field outcomes, a design chart has been developed for an economical geocell-reinforced pavement section for Dholera, India, in compliance with IRC specifications. The study provides valuable insights into the role of geocell materials in pavement infrastructure, supporting its viability as a durable and sustainable option for pavement construction.