Synopsis

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Thesis Title: Experimental Evaluation of Strength and Flexural Response Characteristics of CTSB Mixtures

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Cement-treated sub-base (CTSB) materials are increasingly being adopted in pavement construction due to their improved strength, stiffness, and durability characteristics. The structural performance of stabilized layers is significantly influenced by their tensile and flexural behaviour under traffic loading conditions. Accordingly, the present work focused on assessing how aggregate gradation and cement content affect the engineering response and flexural characteristics of CTSB mixtures intended for pavement use.

Three gradations representing finer, intermediate, and comparatively coarser particle size distributions within the permissible gradation envelope specified in IRC:37-2018 and IRC:SP:89 (Part II)-2018 were selected for investigation. Experimental evaluation was carried out through gradation characterization, compaction behaviour, unconfined compressive strength (UCS), durability assessment, and flexural strength characterization. Compaction characteristics were evaluated using Modified Proctor testing, while strength behaviour was assessed through 7-day and 28-day UCS testing. Durability performance was evaluated using wetting and drying durability

tests, and flexural response characteristics were evaluated through beam testing in accordance with ASTM, IRC, and Austroads stabilized material characterization procedures.

The experimental results demonstrated that gradation characteristics significantly influenced compaction behaviour, strength development, durability response, and flexural behaviour of CTSB mixtures. Gradation 2B, representing an intermediate particle size distribution, exhibited higher compressive and flexural strength values due to better aggregate interlock and stress transfer behaviour. Increase in cement content consistently improved UCS, durability resistance, and modulus of rupture for all investigated gradations.

Durability assessment indicated reduction in soil-cement loss and improvement in residual strength characteristics with increase in cement content, demonstrating enhanced resistance against moisture-induced deterioration. All investigated mixtures satisfied the durability criteria prescribed in IRC:SP:89 (Part II)-2018 for pavement applications.

Flexural strength characterization demonstrated that experimentally obtained modulus of rupture values ranged approximately between 7% and 14% of the corresponding UCS values, which were substantially lower than the empirical approximation of 20% of UCS commonly adopted for Cement treated bases (CTB) recommended in IRC:SP:89 (Part II)-2018. The observed deviation indicated that flexural behaviour of CTSB mixtures cannot be adequately predicted using compressive strength characteristics alone.

A strain-response analytical framework adapted from Austroads stabilized material characterization procedures was also adopted for evaluating bending strain, analytical flexural modulus, and strain-response characteristics relevant to stabilized

pavement applications. The study demonstrated that the structural and flexural behaviour of CTSB mixtures is influenced by the combined interaction between particle size distribution, aggregate interlock, cementitious bonding, tensile response, internal structural characteristics, and durability behaviour.

The present investigation establishes an experimental and analytical framework for evaluating the mechanical and flexural behaviour of CTSB mixtures through direct flexural characterization, durability evaluation, and strain-response interpretation. The findings contribute to improved understanding of cement-treated granular materials and highlight the importance of direct flexural characterization in pavement design and construction.